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Bulletin of the British Museum (Natural History)

A revision of the African pod bugs of the
tribe Clavigrallini (Hemiptera: Coreidae)
with a checklist of the world species

W. R. Dolling

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A revision of the African pod bugs of the tribe Clavigrallini (Hemiptera: Coreidae) with a checklist of the world species

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Synopsis

All known African and Malagasy species of the tribe Clavigrallini are described and a key is provided for their separation. Two genera and 44 species are recognized in the area covered. Two generic and two specific synonymies are newly established, one species is raised from synonymy and three specific synonymies are confirmed. Two subordinate taxa are raised to the rank of species. Twenty-three species are described as new. Twelve new combinations are established, five combinations are revived and one combination is used in its correct sense for the first time. A type-species is designated for one generic name and lectotypes are designated for 18 names in the species-group. Biological information derived from published works and from data labels is summarized for each species. The implications of this revision for the nomenclature of the more important pest species are summarized separately.

Introduction

The general morphology and systematic position of the tribe Clavigrallini, which belongs to the subfamily Pseudophloeinae of the family Coreidae, are discussed by Dolling (1978). That paper and the present work together constitute a complete revision of the tribe.

The tribe is represented throughout the Ethiopian and Oriental regions, extending into tropical Australia and the southern fringes of the Palaearctic region. Of the four genera, two are exclusively Oriental, one (*Oncaspidia* Stål, with a single species) is African and one (*Clavigralla* Spinola) occurs throughout Africa, Madagascar and associated islands and has a few species belonging to one of its more highly evolved sections in the Oriental region.

The major recorded host plants are herbaceous Leguminosae (Fabaceae), including many cultivated pulses. A rapidly growing body of literature exists concerning the bionomics, pest status and control of several species regarded as pests. In the English language these pests are called spiny brown bugs or pod bugs (Afrikaans: Ysterbek).

Clavigrallini may be recognized by their small size (length usually less than 11 mm), generally spiny outline and the characteristically spined, clavate posterior femora (Fig. 185). Where more spines are present on the posterior femur (extreme case in Fig. 124), Clavigrallini may be distinguished from other Pseudophloeinae of similar build by the absence of a tubercle from the base of the posterior femur on its posterior face close to the apex of the trochanter, a feature which is readily visible if present. *Risbecocoris* Izzard lacks this tubercle but is unlikely to be confused with the Clavigrallini. It has several long, laterally directed spines arising from the lateral margins of the pronotum.

Abbreviations of depositories

The specimens studied in the course of this revision are deposited in the various institutions whose names are abbreviated in the text as follows: Museum für Naturkunde der Humboldt-Universität, Berlin, D.D.R. (MNHU, Berlin); Institut Royal des Sciences Naturelles de Belgique, Brussels, Belgium (IRSNB, Brussels); National Museum, Bulawayo, Rhodesia (NM, Bulawayo); Zoological Museum of the University, Helsinki, Finland (ZMU, Helsinki); University of Ife, Ile-Ife, Nigeria (University of Ife); University of Ghana, Legon, Ghana (UG, Legon); the collection of Dr P. Duarte Rodrigues, at present at Museu e Laboratório Zoológico e Antropológico (Museu Bocage), Lisbon, Portugal (Duarte coll.); British Museum (Natural History), London, United Kingdom (BMNH, London); American Museum of Natural History, New York, U.S.A. (AMNH, New York); University Museum, Oxford, United Kingdom (UM, Oxford); Muséum National d'Histoire Naturelle, Paris, France (MNHN, Paris); Plant Protection Research Institute, Pretoria, Republic of South Africa (PPRI, Pretoria); Transvaal Museum, Pretoria, Republic of South Africa (TM, Pretoria); Institute of Agricultural Research, Samaru, Nigeria (IAR, Samaru); California Academy of Sciences, San Francisco, California, U.S.A. (CAS, San Francisco); Naturhistoriska Riksmuseet, Stockholm, Sweden (NR, Stockholm); the private collection of Professor J. A. Slater, at present at University of Connecticut, Storrs, Conn., U.S.A. (Slater coll.); Musée Royal de l'Afrique Centrale, Tervuren, Belgium (MRAC, Tervuren); University of Uppsala, Uppsala, Sweden (University of Uppsala); Naturhistorisches Museum, Vienna, Austria (NM, Vienna).

Terminology and measurements

The segments of the antennae and rostrum are numbered I–IV starting with the segment nearest the body; lengths exclude basal parts of segments capable of retraction into the preceding articulation and also exclude the antennal ring segment between III and IV. The origin of the first rostral segment is taken as the base of the labrum rather than the base of the first labial segment, which is usually concealed, whence the use of the term 'rostrum' ('rostral') in preference to 'labium' ('labial'). The angles at the point of greatest width of the pronotum are termed the posterolateral angles and the spines they bear the posterolateral spines. In the presentation of linear data, ratios are preferred to direct scalar measurements. Where practicable, means, ranges and the number of specimens measured are given, the number of specimens, n , being indicated by the formula ' $(n = x)$ ' following the mean. For a discussion of the rationale of these methods of presenting data see Dolling (1978 : 283).

Systematic section

Key to the genera of *Clavigrallini*

- 1 Side of head above base of antennifer bearing an erect spine (Fig. 1). Pronotum without large spines or tubercles on disc or near lateral margins. (Throughout Ethiopian region except Mascarenes) *ONCASPIDIA* Stål (p. 3)
- Side of head without spine (Figs 9, 51, 137) 2
- 2 Pronotum without large tubercles sublaterally or on disc; female abdomen with apex strongly deflexed; pubescence of pronotum uniform. (Oriental region eastwards to Solomon Islands and northern tropical Australia) *GRALLICLAVA* Dolling (1978 : 304)
- Pronotum with large tubercles on disc or sublaterally or, if without tubercles, pubescence of anterior two-thirds of pronotum strikingly different in colour and texture from that of posterior one-third 3
- 3 Pronotum with a group of four large tubercles on disc. (Oriental region eastwards to New Guinea and northern tropical Australia) *CLAVIGRALLOIDES* Dolling (1978 : 293)
- Pronotum with a pair of large tubercles sublaterally behind level of calli (Figs 138, 157, 188, etc.) or a semicircle of tubercles on disc (Figs 10, 50, 98, 126, etc.), often with additional tubercles but never with a group of four, rarely without tubercles (Fig. 131). (Africa and Mascarenes with a few species in Oriental region eastwards to China and Java) *CLAVIGRALLA* Spinola (p. 6)

ONCASPIDIA Stål

Oncaspidia Stål, 1873 : 81, 83. Type-species: *Clavigralla pilosicollis* Stål, by monotypy.

Length of head about two-thirds length of pronotum. Side of head in front of each eye just above base of antennifer with an erect spine. Antennifer with outer apical process porrect. Antenna with segment I longest, III shortest, IV shorter than II and with specialized sensory area occupying about nine-tenths of its length. Rostrum at rest with apex reaching to disc of metasternum, segment IV slightly longer and II slightly shorter than I, III about two-thirds as long as I. Bucculae small, occupying about one-third of length of ventral midline of head.

Pronotum strongly declivent, posterolateral angles produced, disc without large tubercles or spines, prescutellar spines present, small. Scutellum convex with a pair of small knobs at base. Mesosternum and metasternum broadly and shallowly longitudinally sulcate along midline. Dorsal ridge of metathoracic scent-gland peritreme entire, not bilobed. Anterior and intermediate femora each with 0–1 subapical spine beneath, posterior femur with two major spines and a terminal series, without basal tubercle.

Abdominal sterna III–VII with posterolateral angles prominent. Male genital capsule closed posteriorly, parameres obliquely capitate. Female with valvulae of ovipositor very long in comparison with other Coreidae.

REMARKS. A single species, similar in build to *C. tomentosicollis*, readily distinguished by the spines in front of the eyes. The ovipositor is remarkable for its length, even in comparison with other Pseudophloeinae, in which the structure of the ovipositor tends more towards the 'lacinate' type than that of other Coreidae.

DISTRIBUTION. Tropical and southern Africa.

INCLUDED SPECIES. A single known species, *O. pilosicollis* (Stål).

Description of species

Oncaspidia pilosicollis (Stål)

(Figs 1–8)

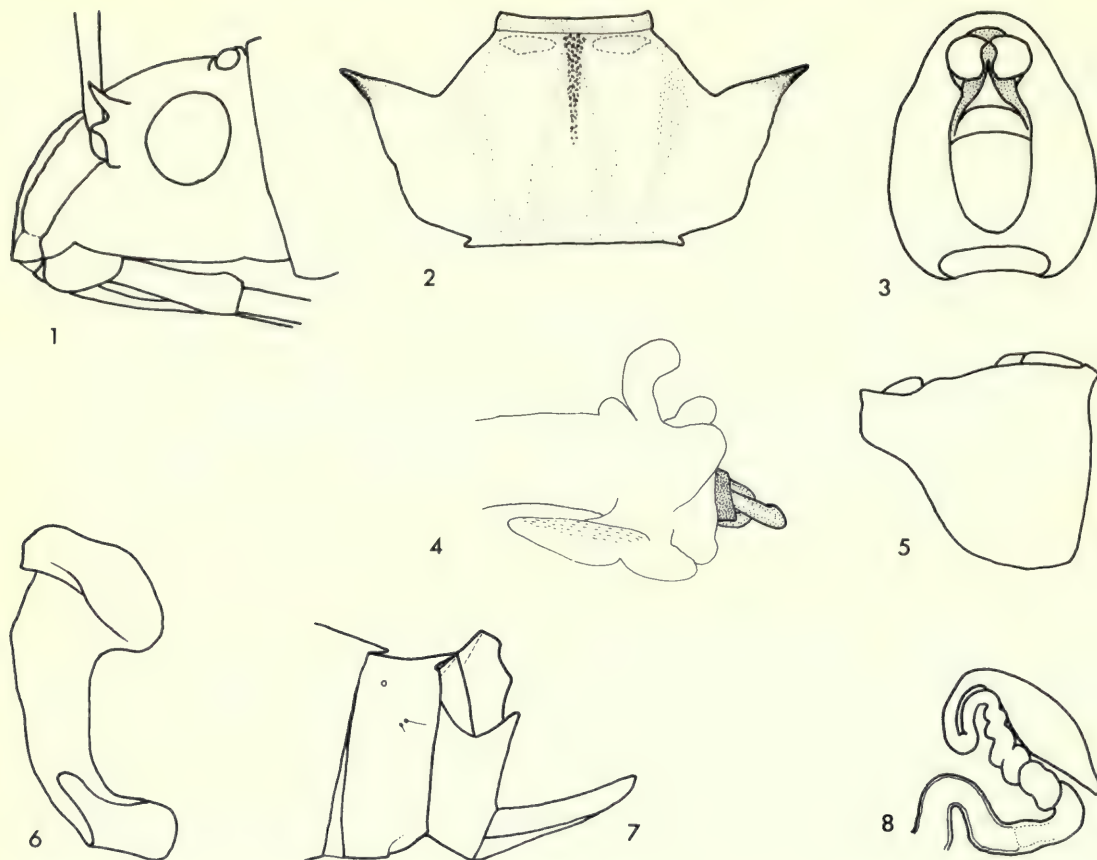
Clavigralla pilosicollis Stål, 1855 : 31. LECTOTYPE ♀, SOUTH AFRICA (NR, Stockholm), here designated [examined].

Clavigralla similis Signoret, 1860 : 944. LECTOTYPE ♂, ZANZIBAR (NM, Vienna), here designated [examined]. [Synonymized by Stål, 1866 : 107.]

Oncaspidia pilosicollis (Stål) Stål, 1873 : 83.

Length: ♂, 7.3–9.1 mm, mean 8.2 mm (n = 11); ♀, 8.2–9.4 mm, mean 9.0 mm (n = 11).

Form robust, deep-bodied.



Figs 1–8 *Oncaspidia pilosicollis*. (1) head, left lateral view; (2) pronotum, dorsal view; (3) genital capsule with parameres, dorsal view; (4) conjunctiva, left lateral view (vesica strongly flexed to right, strongly foreshortened in this view); (5) genital capsule, right lateral view; (6) left paramere, medial view; (7) VII and succeeding segments of ♀ abdomen with ovipositor exserted; (8) spermatheca.

Spine above antennifer slender, curved (Fig. 1); external apical process of antennifer porrect, apically rounded, its dorsal margin flexed inwards almost horizontally. Ratio of lengths of antennal segments I : II : III : IV not differing significantly between the sexes, about 1·00 : 0·80 : 0·65 : 0·86; length of segment I divided by width of head including eyes in both sexes 1·06–1·32, mean 1·17 ($n = 21$). Ratio of lengths of rostral segments I : II : III : IV about 1·00 : 0·90 : 0·70 : 1·08 in both sexes.

Pronotum (Fig. 2) steeply declivent anteriorly, its posterolateral angles rather narrowly produced anterolaterally and tapering into slender spines; width of pronotum across tips of spines divided by width of head including eyes in male 2·62–3·09, mean 2·80 ($n = 11$), in female 2·76–3·07, mean 2·89 ($n = 10$). Corium with apex slightly produced, at rest reaching posteriorly to a point level with the end of the basal third of laterotergite VI. Anterior and intermediate femora each with 0·1 very small subapical spine beneath; posterior femur with 2 major spines, the first about half as long as the second, with about 3 short spines or granules between them, and a terminal series of 4 spines. Posterior tibia not arcuate basally, its length divided by length of posterior femur 0·75–0·84, mean 0·80 ($n = 21$).

Abdominal sternites III–VII each with posterolateral angles drawn out into narrowly triangular spines about one-quarter as long as lateral margin of segment. Male genital capsule (Figs 3, 5) closed posteriorly, lip distinctly produced and pouched, tongue triangular. Paramere with apex capitate (Fig. 6), the capitate ends of the two parameres almost horizontal at rest and largely occluding, in dorsal view, space between tongue and lip of capsule (Fig. 3). Conjunctiva (Fig. 4) with dorsomedian lobe broad, low, transverse; intermediate dorsal lobe broad, high; distal dorsomedian lobe small, rounded; distal dorsolateral lobes

absent; apical ventral lobes small, transverse; distal ventrolateral lobes each with a rounded, membranous, posterior subdivision and a reflexed, dorsally sclerotized, narrow, anterior subdivision; no other lobes sclerotized. Ejaculatory reservoir complex with wings and straps long, symmetrical; vesica long, sclerites protecting its base large, almost symmetrical. Ovipositor with valvulae very long (Fig. 7). Sclerites of dorsal wall of gynatrium narrowly V-shaped, longitudinal arms slightly more than twice as long as transverse arms, both arms ribbon-like in vertical plane. Spermatheca (Fig. 8) with bulb fusiform, duct tightly convoluted in part adjacent to bulb. Ovarian egg (only 1 examined) 1.38×0.52 mm, with 6 micropyles.

Head weakly granulate, antennal segments I–III very weakly and minutely granulate. Pronotum granulate, disc also punctate, propleura granulate-punctate, area of pronotum and propleura immediately anterior to each posterolateral angle with about 8 small, blunt, piceous tubercles. Scutellum with entire surface coarsely and irregularly granulate. Meso- and metapleura granulate-punctate. Clavus seriatly punctate in 3 rows. Corium more weakly punctate than clavus, especially at apex, punctures in basal half seriate. Veins in basal half of corium very weakly granulate. Femora and tibiae minutely and weakly granulate. Abdominal sterna transversely rugose, laterotergites weakly granulate, tergites I and II transversely rugose, III and IV with large, sometimes confluent punctures largely restricted to median half of each, V–VII with smaller punctures occupying whole width of V and VI but restricted to centre third of VII.

Long, erect, colourless pubescence present on head, antennal segments I–III, pronotum, scutellum, thoracic pleura, abdominal sterna and throughout all legs. Shorter, brown, erect pubescence arising from tubercles in anterior midline of pronotum. Shorter, suberect pubescence present on clavus, corium, abdominal laterotergites and rostrum and also mixed with the longer type of hairs on antennae, legs and abdominal sterna, usually colourless but pale or dark brown where it arises from similarly coloured areas of corium. Short to moderately long, generally decumbent and more or less tomentose pubescence present on head, antennal segments I–III (here very sparse), pronotum, scutellum, thoracic pleura, abdominal sterna and femora, usually appearing white or silvery but brown in 4 slightly oblique longitudinal bands on pronotum (Fig. 2).

Colour of integument generally pale pinkish brown. Ocellar tubercles, extreme base of scutellum, anterior midline of pronotum, posterolateral spines of pronotum, ventral surface of head, thoracic sterna, spots on coxae, centre of abdominal sterna II and III and parts of abdominal terga, especially punctures, piceous to black. Antennal segments I–III except for apices, bases of femora, tibiae except for basal, apical and sometimes median annuli, parts of tarsi and almost the whole of laterotergites VI and tergum VII stramineous. Hemelytra with clavus and basal half of corium stramineous, with a few spots on anterior veins dark brown, apical half of corium variegated pale and dark brown, membrane colourless, hyaline.

REMARKS. A distinctive species, as indicated in the generic description above. I follow Stål's (1865 : 107) interpretation of *Clavigralla similis* Signoret, which is based on a specimen in Vienna apparently determined by Stål as being Signoret's type-material. Signoret's (1860 : 944) description is inadequate and confusing.

DISTRIBUTION. Tropical and southern Africa but not Madagascar. Apparently less common in West Africa. Perhaps avoids densely forested areas.

MATERIAL EXAMINED

Clavigralla pilosicollis Stål, lectotype ♀, **South Africa**: 'Caffraria' (J. Wahlb.) (NR, Stockholm). *Clavigralla similis* Signoret, lectotype ♂, **Zanzibar** [bears labels: (1) Zanzibar/ coll. Signoret, (2) similis/ det. Signoret, (3) pilosicollis/ det. Stål] (NM, Vienna).

Liberia: 1 ♀, Kpaine, 30.vii.1953 (W. Peters) (BMNH, London). **Ghana**: 1 ♀, Wegbe, Volta River, 1.xi.1967 (D. Leston) (UG, Legon). **Nigeria**: 1 ♀, Ibadan, 15–19.xii.1975 (J. C. Deeming) (IAR, Samaru). **West Africa**: 3 ♀, 'Cameroons' (ex coll. Distant); 1 ♀, 'W. Afr.' (BMNH, London). **Zaire**: 1 ♀, Kasongo, viii.1959 (P. L. G. Benoit); 1 ♀, Sankuru, M'Pemba Zeo (Gandajika), 9.i.1960 (R. Maréchal) (MRAC, Tervuren); 1 ♂, Ngowa Kwango, 3.ii.1938 (J. Mertens); 1 ♂, Ngowa, 9.v.1939 (R. P. J. Mertens); 1 ♂, Nguela, Usambara (no other data); 1 ♂, Marais Kululu, 8.vi.1939 (H. J. Brédo); 1 ♂, Lubumbashi, 9.iii.1939 (Brédo); 1 ♂, Mpese, v–vi.1937 (R. P. J. Cooreman) (IRSNB, Brussels); 2 ♂, E. of R. Semliki, 1931–1932 (E. B. Worthington); 1 ♀, Katanga, Kambove, 4000–5000 ft (1200–1500 m), 25.iii.1907 (Neave) (BMNH, London). **Uganda**: 1 ♂, Mabira, on dung, 16.viii.1925 (G. L. R. Hancock); 1 ♂, Mbarara, 29.v.1911 (C. C. Gowdey); 1 ♂, top of escarpment N. of Fort Portal, 4700 ft (1430 m), 24.xi.1911 (S. A. Neave); 1 ♀, Mpumu (Miss M. Robertson) (BMNH, London). **Kenya**: 1 ♂, 12 miles (19 km) NW. of Mazeras, c. 500 ft (150 m), 23.ix.1905 (E. B. Poulton) (UM, Oxford); 1 ♂, Chyulu Hills, 5600 ft (1680 m), vii.1938 (Coryndon Mus. Exped.); 1 ♀, Mombasa (van Someren) (BMNH, London). **Tanzania** (Mainland):

1 ♂, Mbeya Mountain, 33° 25' E, 8° 48' S, 7000 ft (2100 m), 5.viii.1959 (*Cambridge Univ. Exped.*); 1 ♂, E. rim of Ngorongoro Crater, 7000 ft (2100 m), 20.vii.1959 (*Cambridge Univ. Exped.*) (BMNH, London). **Zanzibar:** 2 ♂, 1 ♀, i-ii.1925 (*H. J. Snell*) (BMNH, London). **Malawi:** 2 ♂, Mlanje, 1.vii.1913 and 15.viii.1913 (*S. A. Neave*); 1 ♀, Mlanje Boma, 2400 ft (720 m), 26.iv-5.v.1910 (*Neave*) (BMNH, London). **Rhodesia:** 1 ♂, 1 ♀, Mashonaland, Salisbury, 1898 (BMNH, London). **South Africa:** 2 ♂, 3 ♀ (no further locality data) (*A. L. Capener*); 2 ♂, 2 ♀, N. Transvaal, Louis Trichard, 20-30.xii.1956 (*Capener*) (Slater coll.); 8 ♂, 2 ♀, Natal, Durban (AMNH, New York); 1 ♂, 1 ♀, Wonderboom, 12.iii.1905 (*Swierstra*) (TM, Pretoria); 1 ♀, Natal, Lake St Lucia, Charters Creek, 12.xi.1967 (*J. A. & S. Slater, T. Schuh*) (PPRI, Pretoria); 1 ♂, Pondoland, Port St John, 5-30.vi.1928 (*R. E. Turner*); 1 ♂, 1 ♀, Natal, Umbilo, 14.vi.1914 (*L. Bevis*); 3 ♂, 1 ♀, Natal, Malvern, 13.vi.1897, 16.vi.1897, vii.1897, 10.vi.1897; 1 ♂, Zululand, Mtunzini, 7.vi.1926 (*Turner*); 1 ♂, Pretoria, 12.iii.1905 (*C. J. Swierstra*) (BMNH, London).

CLAVIGRALLA Spinola

Clavigralla Spinola, 1837 : 200. Type-species: *Clavigralla gibbosa* Spinola, by monotypy.

Acanthomia Stål, 1873 : 81, 82. Type-species: *Clavigralla natalensis* Stål, by PRESENT DESIGNATION.

Syn. n.

Lancha Shadab, 1972 : 3-7. Type-species: *Myla schnelli* Villiers, by monotypy. **Syn. n.**

Length of head half to three-quarters that of pronotum. Antennifers weakly to strongly divergent, process at outer apical angle of antennifer short and porrect or long and deflexed with its apex in contact with maxillary plate. Side of head in front of eye without spine.

Pronotum rather strongly to very strongly declivent anteriorly, posterolateral angles weakly to very strongly produced, each bearing apically a usually slender spine. Disc of pronotum rarely without tubercles or spines, never with a group of four stout, blunt tubercles in middle, usually with a stout, blunt tubercle or spine close to lateral margin about half way between posterolateral and anterolateral angles, often with a more or less regular, anteriorly concave semicircle of spines or tubercles posterior to this pair. Scutellum equilateral or slightly longer than its basal width, flat to strongly convex, midline impressed in convex forms. Metapleural scent-gland peritreme with dorsal ridge entire and shortly reniform or bilobed. Corium with apex scarcely to distinctly produced.

Abdomen with posterolateral angles of sternites III-VII usually prominent, often strongly and spinously produced. Male genital capsule with lip narrow or broad, often filling posterior emargination of capsule, tongue entire or apically trifid or bifid. Tergum IX of female usually in horizontal plane, rarely apically deflexed. Valves of ovipositor not especially long. Spermatheca with bulb narrowly lunate, duct looped to strongly convoluted. Sclerites of wall of gynatrium basically V-shaped, not deep in vertical plane.

REMARKS. When Stål (1873) differentiated his new genus *Acanthomia* from *Clavigralla* he listed five species under the latter but separated the first of these, *C. horrens* Dohrn, from the remaining four species (including *gibbosa*, the type-species) by a horizontal rule across the page. This convention presumably indicates that he had not seen specimens of the species below the rule. The character he uses to separate *Clavigralla* sensu Stål from *Acanthomia* in his key is the relative lengths of rostral segments II and IV, with IV equal to or longer than II in *Acanthomia* and shorter than II in *Clavigralla*. While IV is slightly shorter than II in *horrens*, it is definitely longer in *gibbosa*. This confirms that *gibbosa*, which is closely related to *tomentosicollis*, was unknown to Stål. I have selected *C. natalensis*, a species described by Stål himself, as type-species of *Acanthomia*. If it were necessary to treat the species related to *elongata* in a different generic or sub-generic taxon from those related to *tomentosicollis* and *gibbosa*, the name *Acanthomia* would be available for the former. However, this course of action seems inadvisable in view of the size of the genus and the fact that a further generic name would be required for *tuberclicollis* and its allies. Shadab (1972) recognized that *Myla schnelli* Villiers did not belong to the genus *Myla* but overlooked its close affinity with *C. elongata* and erected the unnecessary new genus *Lancha* for it.

SPECIES GROUPS AND SUBGROUPS. There are three major external features which may be used as a basis for defining groups of species within the genus. First, the external apical process of the antennifer may be short and porrect (Fig. 9) or long and deflexed (Fig. 51). Secondly, the dorsal

ridge of the metathoracic peritreme may be bilobed (Fig. 12) or entire (Fig. 54). Thirdly, the pilosity of the pronotum may be uniform (Fig. 50) or divided into an anterior area of pale, tomentose pubescence and a posterior area of darker, erect to decumbent pubescence (Fig. 188). On the basis of comparisons with related genera and of correlation with other presumed apomorphies, the second alternative state of each character mentioned seems to be apomorphic with respect to the first. Three groups of species may be recognized: (1) a group of species related to *C. tuberculicollis* in which the apical process of the antennifer is short and porrect, the pubescence of the pronotum is uniform and, except in the case of *C. uelensis*, the dorsal ridge of the metathoracic peritreme is bilobed; (2) a more advanced group related to *C. elongata* in which the apical process of the antennifer is long and deflexed, the dorsal ridge of the metathoracic peritreme is entire and the pubescence of the pronotum uniform; (3) a group of species related to *C. tomentosicollis* which differs from the *elongata*-group in having the pubescence of the anterior and posterior parts of the pronotum dissimilar. *C. uelensis* has probably acquired the entire state of the dorsal ridge of the peritreme independently from the *elongata*- and *tomentosicollis*-groups, as it is very similar in many details to *C. leroyi*. In all members of the *tuberculicollis*-group where the male is known (i.e. all except *C. uelensis*) the posterior lip of the genital capsule does not completely fill the posterior emargination and the apices of the parameres are visible in posterior view (Fig. 11), as in most other Pseudophloeinae, whereas in the *elongata*- and *tomentosicollis*-groups the posterior lip is much better developed and conceals the apices of the parameres in posterior view. This confirms the conclusion that these two groups are more highly evolved than the *tuberculicollis*-group. In the *elongata*-group the pronotum bears numerous to few spines on the disc, usually with some of them organized into a semicircle terminating anteriorly in a pair of sublateral spines (e.g. Fig. 50) as in the *tuberculicollis*-group. In the *tomentosicollis*-group most of the spines are very small and concealed by the pubescence, only the large, sublateral pair being retained (e.g. Fig. 188). Even these are lacking in *C. leontjevi* (Fig. 131). The posterolateral pronotal angles in the *elongata*-group are in general more strongly produced than those of the *tomentosicollis*-group and the posterolateral spines arise less abruptly from them. These two characters tend to confirm the validity of the groups and the relatively greater apomorphy of the *tomentosicollis*-group, as the pattern of pronotal spines and the shape of the posterolateral pronotal angles in the *elongata*-group are shared with the less highly evolved *tuberculicollis*-group.

The *tuberculicollis*-group is too small to warrant subdivision and the *elongata*-group does not usefully lend itself to such treatment as the patterns of relationship within it are obscured by the striking apomorphies of several of its included species. In this group, close relationships obviously exist between *hystrix* and *hystricodes* and between *mira* and *annectans*; *natalensis* is rather isolated and the remainder of the group fall into two series, those in which the veins of the hemelytral membrane are finely pigmented (*elongata* to *schnelli* in the check-list) and those in which they are heavily and broadly pigmented (*insignis* to *aculeata*). The *tomentosicollis*-group can usefully be divided into five subgroups. The first contains only *leontjevi*, which is unique in lacking sublateral pronotal tubercles. It shares the character of an entire tongue in the genital capsule with the next two subgroups. Primitively, the tongue is triangular when seen in dorsal view (Figs 140, 181) with a prominent, ventral, longitudinal keel. There is a tendency for the tongue to become apically rounded and in *C. strabo* (Fig. 170) it appears in dorsal view to be mucronate as the keel can be seen projecting beyond the rounded apex of the dorsal surface of the tongue. In the *ruandana*-subgroup the pigmentation of the hemelytral membrane is almost uniformly diffused and the head is elongate while in the *spiniscutis*-subgroup the membrane is spotted and the head is of normal length for the genus with the exception of *bovilla* in which the head is elongate. Possibly this species would be better placed in the *ruandana* subgroup, although its spotted membrane would be anomalous. The trend in the *ruandana*- and *spiniscutis*-subgroups for the tongue of the genital capsule to depart from the ancestral triangular shape is continued in the *tomentosicollis*-subgroup. Here the tongue is apically emarginate and the apex of the ventral keel projects into this emargination, giving the tongue a trifid appearance (Fig. 194). In all members of this subgroup the pigmentation of the membrane of the hemelytron is evenly diffused. The most highly evolved form of the tongue is encountered in the *wittei*-subgroup, where it is deeply bifid and the keel is greatly reduced (Fig. 222). The hemelytral membrane in the species of this subgroup is spotted.

Key to groups and subgroups

- | | | | |
|---|---|--|---|
| 1 | Antennifer with outer apical process short, porrect (Fig. 9) | <i>tuberculicollis</i> -group (p. 12) | |
| – | Antennifer with outer apical process long, deflexed (Fig. 51) | | 2 |
| 2 | Pubescence of pronotum almost uniform. | <i>elongata</i> -group (p. 19) | |
| – | Pubescence of anterior part of pronotum differing markedly in colour and texture from that of posterior part (<i>tomentosicollis</i> -group) | | 3 |
| 3 | Pronotum without sublateral tubercles (Fig. 131) | <i>leontjevi</i> -subgroup (p. 48) | |
| – | Pronotum with a pair of large, sublateral tubercles (Fig. 138) | | 4 |
| 4 | Tongue of male genital capsule entire | | 5 |
| – | Tongue of male genital capsule apically emarginate | | 6 |
| 5 | Membrane of hemelytron with diffuse pigmentation | <i>ruandana</i> -subgroup (p. 50) | |
| – | Membrane of hemelytron spotted | <i>spiniscutis</i> -subgroup (p. 54) | |
| 6 | Tongue of male genital capsule apically trifid (Fig. 194) | <i>tomentosicollis</i> -subgroup (p. 63) | |
| – | Tongue of male genital capsule apically bifid (Fig. 221) | <i>wittei</i> -subgroup (p. 74) | |

DISTRIBUTION. Tropical and southern Africa, Madagascar and islands adjacent to these, southern Arabia, Oriental region eastwards to Java. The genus is essentially African. Two invasions of the Oriental region have occurred, once by the common ancestor of *gibbosa* and *orientalis* and once by *scutellaris*, which is also present in Arabia and in the more arid areas of Kenya and Sudan. *C. scutellaris* is the sister-species of *C. tomentosicollis*; *orientalis* and *gibbosa* are more distantly related but belong to the *tomentosicollis*-subgroup. All three species-groups are represented in Madagascar and the two known Malagasy species of the *tomentosicollis*-group belong to different subgroups. Only *C. elongata* seems to be present on the more remote and smaller islands in the Ethiopian region, occurring in the Canary and Cape Verde Islands, Principe, São Tomé, Seychelles, Réunion, Mauritius and Rodriguez as well as Arabia (where it is the only species to be found other than *scutellaris*), Madagascar and the African mainland. *C. tomentosicollis* is represented on the Comoro Islands. The area of greatest species diversity is the highlands of central Africa, especially northern Zambia and the vicinity of the Rift Valley. Several species have very wide distributions within Africa. The most important are *tomentosicollis*, *elongata*, *shadabi*, *wittei*, *spiniscutis*, *curvipes*, *simillima*, *leontjevi*, *hystrix* and *hystriodes*. Of these, *curvipes* and *simillima* are sister species with vicarious distributions and *shadabi* appears to be replacing *elongata* in the mainland of West Africa, where *elongata* is restricted to the offshore island groups only, and in lowland central Africa, where the two species coexist over a wide area.

Key to African and Malagasy species

Note. Beware the superficially similar *Oncaspidia* Stål and *Myla* Stål. The former is distinguished by the spine above the base of the antenna (Fig. 1). *Myla* belongs to a large group of genera of Pseudophloeini in which there is a small tubercle close to the base of the posterior face of the posterior femur (Fig. 247). This tubercle is lacking in Clavigrallini. The pubescence of *Myla* is never tomentose.

- | | | | |
|---|---|--|---|
| 1 | Antennifer with apical process short, porrect (Figs 9, 34). | | 2 |
| – | Antennifer with apical process long, deflexed (e.g. Figs 51, 137) | | 5 |
| 2 | Robust species with posterolateral angles of abdominal sternites (Fig. 13) and tubercles and posterolateral angles of pronotum (Fig. 10) very prominent (Madagascar) | <i>C. tuberculicollis</i> (Reuter) (p. 12) | |
| – | Less robust species with posterolateral angles of abdominal sternites (Figs 22, 29, 35) and tubercles and posterolateral angles of pronotum (Figs 20, 21, 27, 31) less prominent. (African mainland, not Madagascar) | | 3 |
| 3 | Metathoracic scent-gland peritreme with dorsal ridge entire (Fig. 33). (Central Africa) | <i>C. uelensis</i> (Schouteden) (p. 18) | |
| – | Metathoracic scent-gland peritreme with dorsal ridge bilobed (as Fig. 12) | | 4 |
| 4 | Pronotum (Fig. 27) with posterolateral angles scarcely produced, width across apices of posterolateral spines divided by width of head including eyes 2·10 or less. (Southern central Africa) | <i>C. zambiae</i> sp. n. (p. 17) | |
| – | Pronotum (Figs 20, 21) with posterolateral angles more strongly produced, width across apices of posterolateral spines divided by width of head including eyes 2·14 or more. (Widespread in tropical Africa from Guinea and Sudan to Angola and Malawi) | <i>C. leroyi</i> (Schouteden) (p. 14) | |

- 5 Pubescence of anterior, declivent part of pronotum of almost uniform colour and texture with that of posterior, horizontal part. Posterolateral angles of pronotum strongly produced, passing gradually into posterolateral spines (e.g. Figs 36, 43, 50, 78, 83, 87-89, 126) 6
- Pubescence of anterior, declivent part of pronotum pale, silvery or golden, tomentose, that of posterior, horizontal part darker, brown, erect to decumbent, the two areas abruptly demarcated each from the other along an almost straight to sharply undulating or zigzag line joining posterolateral angles. Posterolateral angles usually only slightly prominent with spines arising abruptly from them (e.g. Figs 131, 138, 144, 148) 25
- 6 General coloration blackish brown, forewing membrane heavily blotched with dark chocolate brown 7
- General coloration greyish, yellowish or reddish brown, forewing membrane with brown lines generally following course of veins 8
- 7 Antennal segment I longer than 1.7 times width of head including eyes. Antennae with rather obscure pale and dark annulations. (Widespread in equatorial Africa) *C. hystrix* (Dallas) (p. 19)
- Antennal segment I shorter than 1.5 times width of head including eyes. Antennae with conspicuous pale and dark annulations. (Widespread in tropical Africa) *C. hystricodes* Stål (p. 21)
- 8 Scutellum with two longitudinal rows of outstanding, blunt spines on disc (Fig. 123). (South Africa and Rhodesia) *C. horrida* (Germar) (p. 44)
- Scutellum never with outstanding spines 9
- 9 Head with frontal area inflated (Figs 97, 243). 10
- Head with frontal area declivent from behind level of antennae (Fig. 51) 11
- 10 Distal dorsomedian lobe of conjunctiva bearing sclerotized appendages (Figs 100, 101). (Western, central and eastern Africa) *C. mira* sp. n. (p. 36)
- Conjunctiva without sclerotized appendages (Figs 245, 246). (Zaire) *C. annectans* sp. n. (p. 38)
- 11 Pronotum (Fig. 126) with posterolateral lobes and spines very short. Scutellum weakly convex. Spines at posterolateral angles of abdominal sterna very small (Fig. 128). (Southern Africa) *C. natalensis* Stål (p. 46)
- Pronotum (e.g. Figs 50, 104, 117) with posterolateral angles and spines more strongly produced. Scutellum usually more strongly convex and abdominal spines longer 12
- 12 Pubescence of head, pronotum and scutellum not or poorly organized into narrow, longitudinal lines of white hairs; if such pale lines are partially discernible they are never present on declivent part of pronotal disc posterior to calli. Forewing membrane colourless, its veins finely picked out in brown. (Several common species, throughout Africa and Madagascar). 13
- White pubescence organized into conspicuous, narrow longitudinal lines on head, pronotum and scutellum, including three lines traversing entire length of pronotum. Forewing membrane with broad bands of brown coloration following course of veins and usually spreading onto membrane between veins especially on disc. (Species of restricted distribution, mostly confined to high ground in eastern, central and southern Africa; not known from West Africa or Madagascar) 19
- 13 Scutellum flat, not elevated above level of posterior margin of pronotum. Pronotum with posterolateral angles strongly produced anterolaterally (Figs 87, 88, 89, 91). (Western and central Africa). *C. schnelli* (Villiers) (p. 34)
- Scutellum convex (Figs 53, 77), elevated above level of posterior margin of pronotum when viewed in profile 14
- 14 Spines at posterolateral angles of abdominal sternites long, almost perpendicular to lateral margins of abdomen (Figs 79, 80). Scutellum without long, erect pubescence (Madagascar only) 15
- Spines at posterolateral angles of abdominal sternites shorter, usually distinctly deflected posteriad (Fig. 52). Scutellum with at least some long, erect pubescence (Africa and Madagascar) 16
- 15 Antennal segment I longer than 1.4 times width of head including eyes. Produced, posterolateral angles of pronotum and of abdominal sternites (Figs 78, 79) more slender. (Madagascar) *C. madagascariensis* sp. n. (p. 31)
- Antennal segment I shorter than 1.4 times width of head including eyes. Produced, posterolateral angles of pronotum and of abdominal sternites (Figs 83, 80) stouter. (Madagascar) *C. asterix* sp. n. (p. 33)
- 16 Scutellum moderately convex and strongly tuberculate (Fig. 77). (Madagascar) *C. ankatsoensis* sp. n. (p. 31)
- Scutellum strongly convex with less prominent tuberculation (Fig. 53) 17

- 17 Head short (Fig. 72). Tibiae with dark, basal, apical and median annuli. (West and central Africa) *C. breviceps* sp. n. (p. 30)
- Head longer (Figs 50, 66). Tibiae without dark, median annuli. 18
- 18 Semicircle of spines on disc of pronotum with anterior pair much more prominent than the pair behind them (Fig. 66). (West and central Africa) *C. shadabi* sp. n. (p. 28)
- Semicircle of spines on disc of pronotum with the first two pairs of spines of comparable size (Fig. 50). (Central, eastern and southern Africa and Canary Is., São Tomé, Príncipe, Seychelles, Madagascar, Réunion, Mauritius, Rodriguez, S. Arabia) *C. elongata* Signoret (p. 24)
- 19 Width across apices of posterolateral spines of pronotum greater than 3.0 times width of head including eyes 20
- Width across apices of posterolateral spines of pronotum less than 3.0 times width of head including eyes 21
- 20 Length of antennal segment I greater than 1.6 times width of head including eyes. Spinously produced posterolateral angles of abdominal sternites perpendicular to lateral margins of abdomen. Width of pronotum across apices of posterolateral spines more than 3.5 times width of head including eyes. (Malawi) *C. egregia* sp. n. (p. 41)
- Length of antennal segment I less than 1.6 times width of head including eyes. Spinously produced posterolateral angles of abdominal sternites deflected posteriad. Width of pronotum across apices of posterolateral spines less than 3.5 times width of head including eyes. (Zambia, Zaire) *C. longispina* sp. n. (p. 43)
- 21 Posterolateral spines of abdominal sternites more nearly perpendicular to lateral margins of abdomen and broader at the base (Figs 113, 115) 22
- Posterolateral spines of abdominal sternites strongly deflected posteriad and narrower (Fig. 106) 23
- 22 Width of pronotum across apices of posterolateral spines greater than 2.9 times width of head including eyes. Male paramere with apical tooth less prominent (Fig. 114). (Angola) *C. angolensis* sp. n. (p. 41)
- Width of pronotum across apices of posterolateral spines less than 2.9 times width of head including eyes. Male paramere with apical tooth more prominent (Fig. 119). (South Africa) *C. aculeata* sp. n. (p. 43)
- 23 Scutellum weakly convex (Fig. 108). Male paramere with apical margin strongly oblique (Fig. 111). (East Africa) *C. andersoni* sp. n. (p. 41)
- Scutellum strongly convex (Fig. 107). Male paramere with apical margin less strongly oblique (Figs 109, 110) 24
- 24 Male paramere with apical margin straight, blade longer in relation to shaft (Fig. 109). (Highlands of central Africa) *C. insignis* (Distant) (p. 39)
- Male paramere with apical margin convex, blade shorter in relation to length of shaft (Fig. 110). (Burundi) *C. minor* (Schouteden) (p. 39)
- 25 Pronotum without large, blunt tubercles at sides of disc (Fig. 131). (Western, central and eastern Africa) *C. leontjevi* (Bergróth) (p. 48)
- Pronotum with a pair of large, usually blunt tubercles at sides of disc behind level of calli (e.g. Figs 188, 209, 220) 26
- 26 Membrane of hemelytron with disc evenly suffused with pale to medium brown coloration, rarely with a few spots of slightly more intense pigmentation between longitudinal veins near basal cells, in which case male genital capsule with tongue trifid 27
- Membrane of hemelytron largely colourless or very faintly milky white, with 1–5 brown or piceous spots between bases of longitudinal veins where these emerge from basal cells (Fig. 219); spots sometimes very faint; membrane occasionally with more extensive piceous blotching (Fig. 178); tongue of male genital capsule never trifid 34
- 27 Length up to 8.5 mm (largest females); posterior tibia short, strongly arcuate at base (Fig. 212) 28
- Length greater than 8.5 mm except for smallest males, in which case posterior tibia long and only weakly arcuate at base (Fig. 185) 29
- 28 Antennal segment I slender (Fig. 211). (Tropical Africa north of latitude 3° S) *C. curvipes* (Stål) (p. 70)
- Antennal segment I stouter (Fig. 210). (Africa south of latitude 6° S) *C. simillima* sp. n. (p. 73)
- 29 Length of antennal segment I divided by width of head including eyes 1.11 or less and head elongate (Fig. 137). Male genital capsule with tongue entire 30

- Length of antennal segment I divided by width of head including eyes greater than 1.11 or, if less, head not elongate (Figs 187, 189) and tongue of male genital capsule trifid (Fig. 194) 31
- 30 Pronotum with posterolateral spines very short (Fig. 148). Abdominal sternites with posterolateral angles not at all prominent (Fig. 150). (Northern Zambia) *C. oxonis* sp. n. (p. 53)
- Pronotum with posterolateral spines longer (Fig. 138). Abdominal sternites with posterolateral angles distinctly prominent (Fig. 139). (Highlands of central Africa) *C. ruandana* (Schouteden) (p. 50)
- 31 Pronotum with posterolateral spines directed strongly posteriad (Fig. 144). Male genital capsule with tongue entire. (Highlands of central Africa) *C. biston* sp. n. (p. 52)
- Pronotum with posterolateral spines directed laterad (Figs 188, 190, 203). Male genital capsule with tongue trifid 32
- 32 Band of dark pubescence on pronotum posterior to posterolateral angles almost completely divided into two by a narrow, V-shaped, median, longitudinal band of pale pubescence (Fig. 203). Posterior tibia distinctly arcuate at base. (Madagascar) *C. annulipes* Signoret (p. 70)
- Band of dark pubescence on pronotum posterior to posterolateral angles not divided (Figs 188, 190). Posterior tibia only weakly arcuate at base (Fig. 192). (Not occurring in Madagascar) 33
- 33 Pronotum with area of pale pubescence completely divided by dark, longitudinal band, junction with area of dark pubescence with two small, posteriorly projecting extensions of pale pubescence close to midline (Fig. 188). (Africa south of the Sahara except for the north-eastern part; Comoro Is.) *C. tomentosicollis* Stål (p. 63)
- Pronotum with area of pale pubescence incompletely divided, junction of pale and dark areas following a gently undulating line without distinct, narrow projections of pale pubescence into dark area (Fig. 190). (Northern Kenya, Sudan, Arabia, SW. Asia) *C. scutellaris* (Westwood) (p. 69)
- 34 Form of body depressed. Scutellum only moderately convex (Figs 231, 232). Abdominal sternites with posterolateral angles only slightly prominent (Figs 233, 234). Pronotum with posterolateral angles triangularly prominent, their spines very short (Figs 229, 230). Length of antennal segment I divided by width of head including eyes 0.80 or less 35
- Deeper bodied. Scutellum usually more strongly convex. Abdominal sternites with posterolateral angles usually more strongly produced (Figs 154, 158, 169, 179, 224). Posterolateral angles of pronotum, if produced, not triangularly so, their spines longer (Figs 157, 166, 167, 177, 220). Length of antennal segment I divided by width of head including eyes greater than 0.80 36
- 35 Abdominal spines slightly shorter (Fig. 233). Body and appendages with all erect hairs shorter than transverse dorsal diameter of eye. (Highlands of north-east and central Africa) *C. alpica* (Bergróth) (p. 77)
- Abdominal spines slightly longer (Fig. 234). Many erect hairs on head, thorax and appendages as long as transverse dorsal diameter of eye (e.g. pubescence of scutellum, Fig. 232). (Cameroun) *C. montana* sp. n. (p. 80)
- 36 Antennal segment I very long, its length greater than 1.3 times width of head including eyes. Posterior tibia very weakly arcuate at base (Fig. 185), more than 0.75 times length of posterior femur. (Southern Africa) *C. marmorata* sp. n. (p. 63)
- Antennal segment I shorter than 1.25 times width of head including eyes or, if longer, then posterior tibia more strongly arcuate at base and not exceeding 0.70 times length of posterior femur 37
- 37 Posterolateral angles of abdominal sternites very weakly produced (Fig. 154). Head elongate (as in *ruandana*, Fig. 137). (Zambia) *C. bovilla* sp. n. (p. 54)
- Posterolateral angles of abdominal sternites more strongly produced (Figs 158, 169, 179, 224). Head less elongate 38
- 38 Male genital capsule with tongue narrowly triangular. (Madagascar). *C. pusilla* sp. n. (p. 56)
- Male genital capsule with tongue of various shapes but never narrowly triangular. (Not in Madagascar) 39
- 39 Pronotum with posterolateral angles rather strongly produced (Fig. 220). Male genital capsule with tongue bifid 40
- Pronotum with posterolateral angles weakly produced (Figs 166, 167, 175, 177). Male genital capsule with tongue entire 41
- 40 Length greater than 7.5 mm. Lobes of tongue of male genital capsule laminar, externally and apically deflexed (Fig. 221). (Widespread in Africa) *C. wittei* (Schouteden) (p. 74)

- Length less than 7.5 mm. Lobes of tongue of male genital capsule cylindrical (Fig. 222). (Uganda, Zaire) *C. neavei* sp. n. (p. 77)
- 41 Posterior tibia not arcuate at base. Antennal segment I with many outstanding hairs longer than diameter of segment. Tongue of male genital capsule apically rounded (Fig. 170). (Southern Africa) *C. strabo* sp. n. (p. 57)
- Posterior tibia gently or strongly arcuate at base. Antennal segment I with no hairs as long as its diameter 42
- 42 Posterior tibia gently arcuate at base. Tongue of male genital capsule narrow, truncate (Fig. 174). (Southern Africa) *C. pabo* sp. n. (p. 59)
- Posterior tibia strongly arcuate at base (as in *C. simillima*, Fig. 212). Tongue of male genital capsule broad, mucronate (Fig. 181). (Widespread in Africa) *C. spiniscutis* (Bergróth) (p. 60)

Descriptions of species

The *tuberculicollis*-group

Antennifer with apical process short, porrect; metathoracic peritreme with dorsal ridge bilobed or entire; male genital capsule with tongue entire; lip of genital capsule not completely filling posterior emargination in posterior view; pubescence of anterior, declivent area of pronotum uniform with that of posterior, horizontal area.

Clavigralla tuberculicollis (Reuter) comb. n.

(Figs 9–18)

Acanthomia tuberculicollis Reuter, 1887 : 90. Holotype ♀, MADAGASCAR [destroyed].

Length: ♂, 9.7–10.8 mm, mean 10.2 mm (n = 7); ♀, 11.0–11.5 mm, mean 11.3 mm (n = 5). Body robust, connexivum broad.

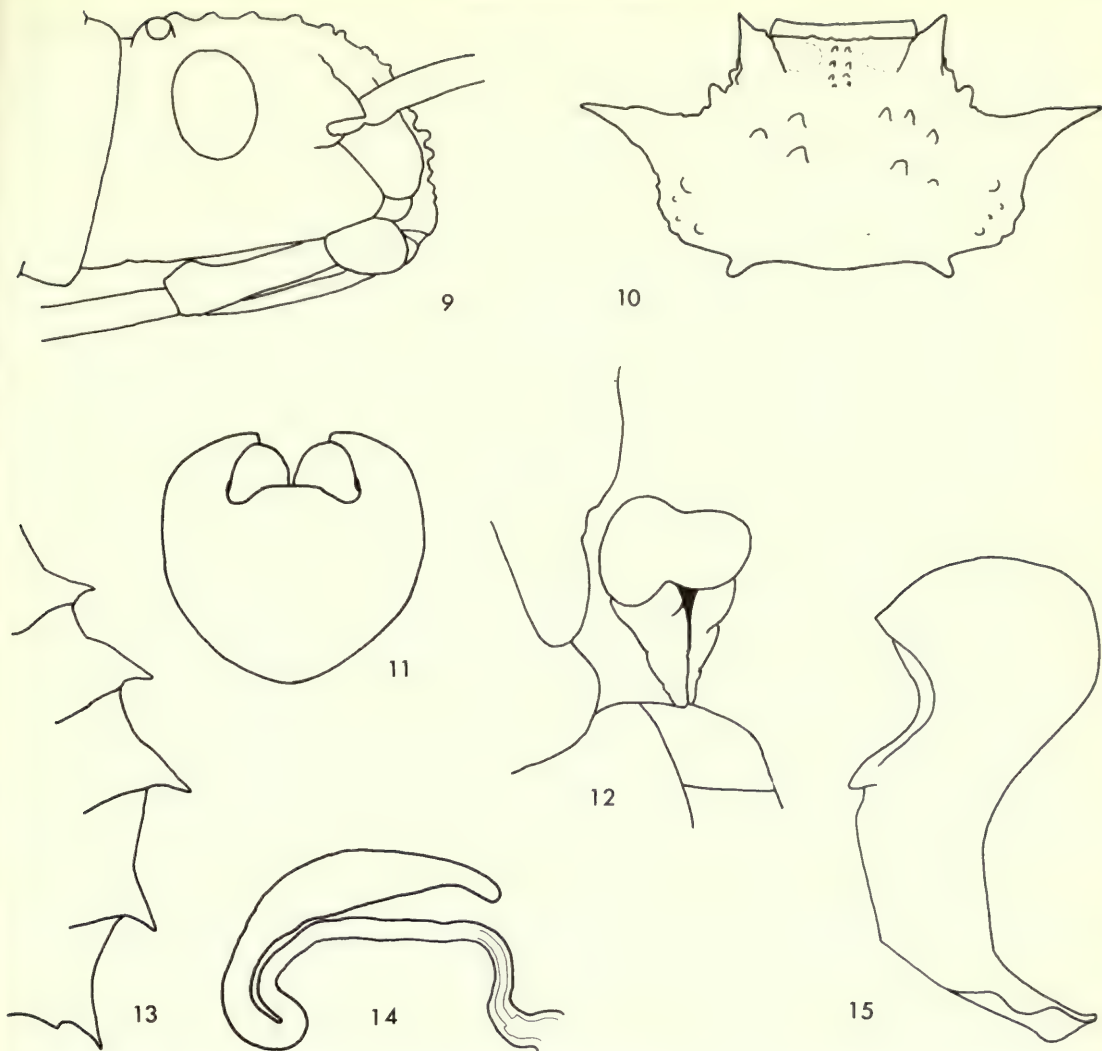
Antennifers strongly divergent, outer apical angle of each with a well-developed, porrect, triangular process (Fig. 9). Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.91 : 0.83 : 0.83, in female about 1.00 : 0.92 : 0.84 : 0.71. Length of antennal segment I divided by width of head including eyes in male 1.23–1.28, mean 1.26 (n = 7), in female 1.29–1.44, mean 1.35 (n = 4). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.89 : 0.57 : 0.88.

Pronotum (Fig. 10) strongly declivent, disc tuberculate, sublateral pair of spines very prominent and robust, posteriorly with a raised ridge parallel to posterior margin, the ridge expanded medially to form a low boss. Width of pronotum across apices of posterolateral spines divided by width of head including eyes in male 2.67–2.91, mean 2.84 (n = 7), in female 2.67–3.21, mean 2.94 (n = 4). Scutellum strongly convex, disc with a pair of prominent tubercles, apex elevated slightly and knobbed. Metathoracic scent-gland peritreme (Fig. 12) with dorsal ridge bilobed, anterior lobe slightly larger than posterior. Corium with apex slightly produced, at rest reaching level of suture between laterotergites V and VI. Anterior and intermediate femora each with a single, strong, subapical spine beneath. Posterior femur subapically with a rather small major spine followed after a short space by a larger major spine and a terminal series of 4 spines decreasing in length towards apex of femur. Posterior tibia almost straight, about 0.88 times length of posterior femur.

Abdominal sterna III–VII with posterolateral angles produced into broad, triangular teeth (Fig. 13). Male genital capsule (Fig. 11) with lip small, not filling posterior emargination, tongue long and narrowly triangular. Paramere (Fig. 15) broad and flattened. Aedeagus (Figs 16–18) with conjunctival lobes all membranous; dorsomedian and intermediate dorsal lobes broad, low, M-shaped, distal dorsolateral lobes long, distal dorsomedian lobe narrow, finger-like, small, proximal ventrolateral lobes present, distal ventrolateral lobes long, apical ventral lobes large. Female sternum VII narrow, especially in midline, cleft for about one-third of its length. Second valvula truncate apically. Sclerites of gynatrial wall simply V-shaped. Spermatheca (Fig. 14) with bulb long and narrow, duct rather short and scarcely convoluted.

Antennal segments I–III minutely granulate; head granulate, more coarsely in dorsal midline. Pronotum sparsely punctate posteriorly, granulate anteriorly, tuberculate along lateral and posterolateral margins. Scutellum, apart from the two prominent tubercles, and thoracic pleura sparsely punctate-granulate. Thoracic sterna minutely rugose. Legs almost smooth, posterior femora with a few shallow punctures in apical half. Clavus and corium except for apex evenly punctate, corium with veins anteriorly in basal half bearing a few large granules. Abdominal sterna and laterotergites neither granulate nor punctate.

Antennae with short to moderately long, suberect, brown pubescence, segment I also with short, adpressed, silvery hairs, head with both of these types of pubescence throughout. Pronotum, scutellum and



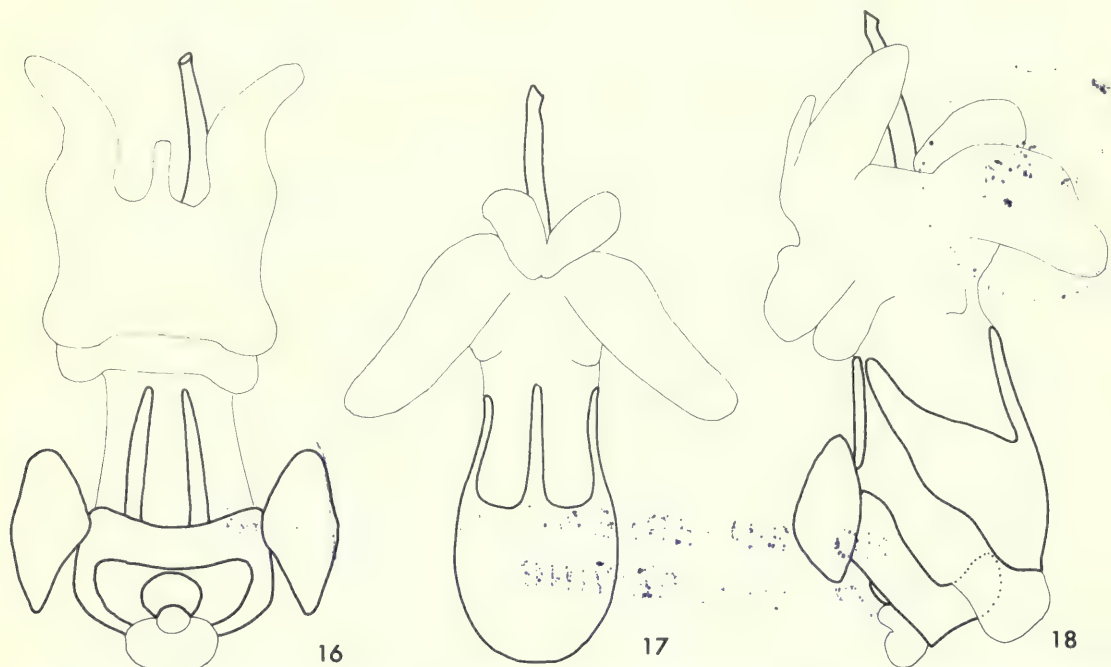
Figs 9-15 *Clavigralla tuberculicollis*. (9) head, right lateral view; (10) pronotum, dorsal view; (11) genital capsule with parameres, posterior view; (12) left metathoracic peritreme, lateral view; (13) lateral margins of ♂ abdominal sternites III-VII, ventral view; (14) spermatheca; (15) paramere, dorsal view.

thoracic pleura with moderately long to long, erect, brown hairs and a thin covering of adpressed, silvery hairs, the latter type only present on thoracic sterna. Legs with short to long, semidecumbent to erect, pale or dark brown hairs, femora and tibiae, especially near base, with sparse, adpressed, silvery hairs also. Clavus and corium with short, suberect, pale brown hairs. Abdominal sternites with sparse, moderately long, erect, pale hairs and a thin covering of short, adpressed, silvery hairs; laterotergites with short, slightly crisped, semidecumbent, pale brown hairs.

Colour generally dark brown to piceous. Antennae pale brown with obscure stramineous rings. Tarsi, two broad rings on each tibia, some large spots in apical half of each femur and most of basal half of all femora pale brown to stramineous, legs otherwise piceous. Clavus and corium mid-brown, apex of corium piceous with small cream spots, apical margin of corium cream with a few piceous spots. Punctures of clavus and corium piceous. Membrane fuscous with indistinct, paler blotches. Abdominal sterna with creamy yellow markings which are most extensive on disc of sternites IV and V and sides of VII. Laterotergites IV, V and VI each with a transverse cream-coloured band, VII almost entirely cream.

REMARKS. This species is distinguished from all others with a short, non-deflexed process at the apex of the antennifer by its large size and dark coloration. It is the only species of its group so far recorded from Madagascar. The unique holotype, collected in Nossibé, was deposited by Reuter in the Naturhistorisches Museum, Lübeck. The entomological collections of this museum were totally destroyed by bombing and subsequent fire on 28–29 March 1942 (Anonymous, 1947).

DISTRIBUTION. Madagascar.



Figs 16–18 *Clavigralla tuberculicollis*. (16) aedeagus and basal apparatus, dorsal view; (17) aedeagus, ventral view; (18) aedeagus and basal apparatus, left lateral view.

MATERIAL EXAMINED

Madagascar: 1 ♂, 1 ♀, 1900 (*Fairmaire*) (MNHN, Paris); 1 ♂, 3 ♀, Diego Suarez, 1893 (*Ch. Alluaud*) (MNHN, Paris and BMNH, London); 3 ♂, Région du Sud, Andrahomana, 1901 (*Alluaud*) (MNHN, Paris and BMNH, London); 1 ♂, Bezanozano, 1898 (*Noualhier*) (MNHN, Paris); 1 ♂, Ambovombe, 1925 (*R. Decary*) (BMNH, London); 1 ♀, Région du Sud de l'Isle, Bekily, viii.1936 (*A. Seyrig*) (MNHN, Paris).

Clavigralla leroyi (Schouteden) comb. n.

(Figs 19–26)

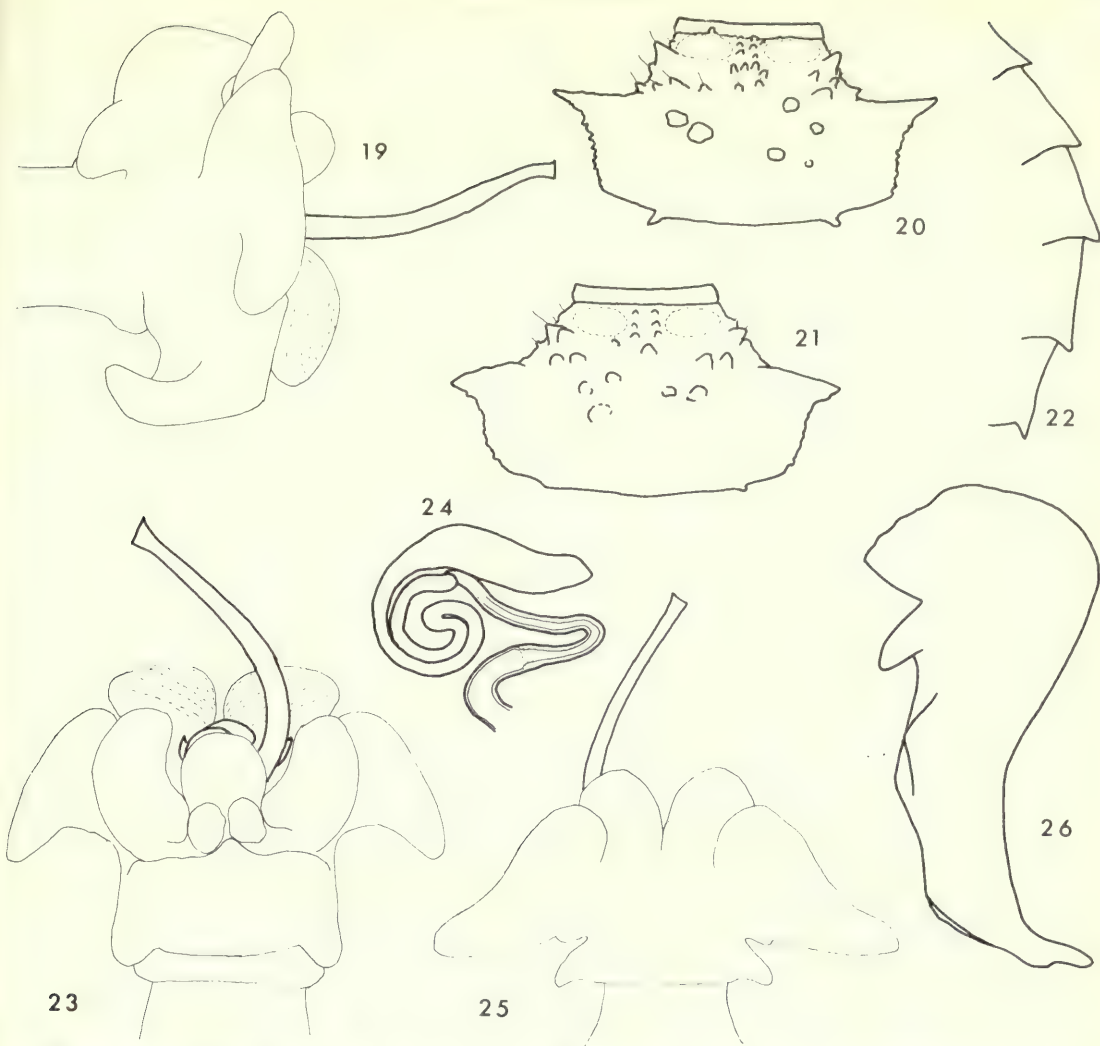
Acanthomia leroyi Schouteden, 1938 : 290. LECTOTYPE ♂, ZAIRE (MRAC, Tervuren), here designated [examined].

Acanthomia mixta Schouteden, 1938 : 290–291. LECTOTYPE ♂, ZAIRE (MRAC, Tervuren), here designated [examined]. **Syn. n.**

Length: ♂, 8.3–9.8 mm, mean 9.0 mm ($n = 28$); ♀, 8.8–10.8 mm, mean 9.5 mm ($n = 25$).

Antennifers strongly divergent, process at external apical angle well developed, triangular, porrect. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.92 : 0.76 : 0.91, in female about 1.00 : 0.92 : 0.78 : 0.85. Length of segment I divided by width of head including eyes in male 1.03–1.25, mean 1.15 ($n = 27$), in female 1.07–1.44, mean 1.19 ($n = 23$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.85 : 0.52 : 0.79.

Pronotum moderately strongly and convexly declivent, disc with a stout, conical tubercle near mid-point of each anterolateral margin and several other spines and tubercles of similar size, the more



Figs 19–26 *Clavigralla leroyi*. (19) conjunctiva, left lateral view; (20) pronotum of ♂ lectotype of *mixta*, dorsal view; (21) pronotum of ♂ lectotype of *leroyi*, dorsal view; (22) lateral margins of ♀ abdominal sterna III–VII, ventral view; (23) conjunctiva, dorsal view; (24) spermatheca; (25) conjunctiva, ventral view; (26) left paramere, dorsal view.

posterior ones being blunt, apically rounded and approximately hemispherical in form. Prescutellar spines small or absent. Posterolateral angles moderately produced, posterolateral spines variable in length, thickness and direction, generally slightly anterolaterally directed if longer and thinner (Fig. 20) and slightly posterolaterally directed if shorter and thicker (Fig. 21), but various intermediates and combinations of features occur. Width of pronotum across apices of posterolateral spines divided by width of head including eyes in male 2.14–2.65, mean 2.35 ($n = 27$), in female 2.24–2.95, mean 2.43 ($n = 25$). Posterolateral spines in male more usually directed forwards and in female more usually directed laterally, but not consistently so in either sex. Scutellum distinctly but rather weakly convex, granulate. Dorsal ridge of metathoracic scent-gland peritreme bilobed, the lobes subequal in size or the anterior one slightly larger. Apical margin of corium only very shallowly concave, apex scarcely produced, when at rest attaining only level of suture between laterotergites V and VI or slightly exceeding this. Anterior and intermediate femora each with 1 small subapical spine beneath, posterior femur with 2 major subapical spines, the more basad less than half the length of the other, with or without a small spine or tubercle between them and

with an apical series of 4 spines, very rarely a third, minute, major spine is discernible basad of the sub-apical group. Posterior tibia straight, about 0.93 times length of posterior femur.

Abdominal sternites III–VII with posterolateral angles prominent as small, triangular spines (Fig. 22). Male genital capsule with lip shallow, obtusely angled or truncate, not filling posterior emargination, tongue triangular, entire. Paramere (Fig. 26) with the two teeth on inner side about equally prominent and forming a slightly acute angle between themselves. Conjunctiva (Figs 19, 23, 25) with dorsomedian lobe low, simple; intermediate dorsal lobe large, its lateral angles slightly prominent and its apex triangularly produced posteriad; distal dorsomedian lobe small, bifid; distal dorsolateral lobes deflexed; posterior face of conjunctiva with a single, subspherical lobe above the large, paired sclerites protecting the coiled base of the vesica; apical ventral lobes large, with dorsal surface lightly sclerotized and ornamented with numerous small warts; distal ventrolateral lobes large; paired ventral lobes present at level of dorsomedian lobe. Vesica with non-coiled portion about as long as conjunctiva, sclerites protecting its base about equal in length to straps of ejaculatory reservoir complex. Female sternum VII cleft along distal third of ventral midline. Spermatheca (Fig. 24) with duct nearest to bulb curving in three-quarters of a circle round towards bulb, then turning back on itself and forming another three-quarters circle closely appressed to inside of first loop, followed by a small kink and a U-shaped loop; thin-walled portion of duct not quite half length of bulb.

Head and antennal segment I weakly granulate, antennal segments II and III minutely granulate. Pronotum bearing granules of a wide range of sizes, disc punctuate. Scutellum with large granules mostly arranged in two parallel, longitudinal bands. Thoracic pleura granulate-punctuate. Thoracic sterna and abdominal sternites and laterotergites almost lacking in macrosculpture apart from weak transverse striations on abdominal sternites. Abdominal tergites I and II transversely striate, III with a group of about 12 large, often confluent punctures in middle, IV–VII with smaller punctures throughout, decreasing in size and density laterally and posteriorly. Clavus seriatly punctate in about four rows, corium punctate throughout, seriatly so basally, veins in basal half granulate. Femora very weakly and tibiae minutely granulate.

Pubescence all white to silvery, fine. Short, decumbent pubescence present on head, pronotum, scutellum, thoracic pleura and sterna, abdominal sterna and, sparsely, on femora and antennal segment I, often organized into a conspicuous white line along midline of posterior lobe of pronotum and scutellum. Short, semidecumbent pubescence present on abdominal laterotergites, clavus and corium. Rather short, suberect pubescence present on head, pronotum, scutellum and all antennal segments, rostrum and legs. Longer, suberect to erect pubescence also present on antennal segment I, dorsum of head, femora, tibiae, tarsi, pronotum and abdominal sterna.

Colour generally grey-brown, mottled. Dorsum of head, pronotum and scutellum reddish brown; head with a pair of cream-coloured stripes running along inner border of compound eyes and thence towards posterior margin of head, slightly convergent posteriorly and usually edged narrowly piceous; ocellar tubercles often piceous. Larger spines and tubercles of pronotum and often lateral margins and raised apex of scutellum also piceous. Head laterally and ventrally red-brown but usually largely or almost entirely covered with piceous markings. Thoracic pleura red-brown with piceous markings; sterna entirely piceous. Abdominal sterna red-brown with numerous, variable, cream and piceous markings, sterna III–VII almost always with diagonal piceous and cream markings about half-way between midline and lateral margins. Laterotergites red-brown, each with a transverse pale cream band occupying the middle third. Clavus and corium pale grey-brown, corium with a few spots and granules brown, veins at and near its apical margin partly or largely cream; membrane slightly infusate, veins brown, interrupted by unpigmented areas. Antennae pale flavous, often tinged rufous, segments I–III typically each with a line along dorsolateral surface and an apical annulus not continuous with the line red-brown to piceous or black, these darker antennal markings sometimes more extensive and sometimes absent. Legs stramineous; femora heavily marked with irregular, red-brown and frequently also piceous spots, especially in apical two-thirds; tibiae each with a basal and apical annulus and a median dorsal spot or complete annulus red-brown or piceous; base and apex of first and second tarsal segments and whole of third tarsal segment of all legs red-brown.

Egg with 9 aeromicropyles (3 ovarian eggs taken from a single female).

REMARKS. There is considerable but continuous variation in the shape of the pronotum and the extent of piceous markings, which may be completely absent. These characters vary independently. The complex form of the conjunctiva and that of the spermatheca, however, show little variation, suggesting that the material examined comprises a single, variable species rather than a complex of closely similar species. The type-series of *Acanthomia leroyi* comprises specimens with short, laterally directed pronotal posterolateral spines (Fig. 21) and about average intensity

and extent of the piceous markings while the type-specimens of *A. mixta* have longer, anterolaterally directed pronotal posterolateral spines (Fig. 20) and more extensive piceous markings.

DISTRIBUTION. Central and West Africa, usually at high altitudes.

MATERIAL EXAMINED

Acanthomia leroyi Schouteden, lectotype ♂, **Zaire**: Ituri, Nioka, vii.1934 (*J. V. Leroy*) (MRAC, Tervuren).
Acanthomia mixta Schouteden, lectotype ♂, **Zaire**: Ituri, Nioka, vii.1934 (*J. V. Leroy*) (MRAC, Tervuren).
Guinea: 2 ♀, Mt To, 1660 m, 28.vi.1954 (BMNH, London). **Sudan**: 1 ♂, W. Darfur, S. Jebel Murra, Dimbiti, 7600 ft (2350 m), 28.v.1932 (*M. Steele*) (BMNH, London). **Ethiopia**: 1 ♂, Lake Zwai, v.1914 (*O. Kovacs*); 1 ♂, Maraco, 8.iv.1915 (*Kovacs*); 1 ♀, Urgessa, R. Simu, 2300 ft (700 m), 3.v.1905 (*Ph. C. Zaphiro*) (BMNH, London). **Uganda**: 1 ♀, Kampala, 15–30.x.1917 (*C. C. Gowdey*) (BMNH, London).
Burundi: 1 ♂, Mugeru, end of 1965 (*J. J. Rwabuneza*) (MRAC, Tervuren). **Zaire**: 1 ♂, 2 ♀, Ituri, Nioka, vii.1934 (*J. V. Leroy*) (paralectotypes of *Acanthomia leroyi* Schouteden) (MRAC, Tervuren); 1 ♂, 2 ♀, Ituri, Nioka, vii.1934 (*J. V. Leroy*) (paralectotypes of *Acanthomia mixta* Schouteden) (MRAC, Tervuren); 1 ♂, Kinda, N'Zazi, 15.i.1949 (*R. P. Lefebvre*); 1 ♂, Lualaba, Jadotville, Kakanda, vii–viii.1953 (*R. P. Th. de Caters*); 1 ♀, Bas-Congo, Lemfu, x–xii.1944 (*Rév. P. De Beir*); 1 ♂, Lulua, Kapanga, ii.1933 (*F. G. Overlaet*); 3 ♀, Lulua, Kapanga, 14.xii.1932, i.1933 and iii.1933 (*Overlaet*); 1 ♂, Kivu, Mulungu, 1939 (*Hendrickx*); 1 ♀, Kivu, Mulungu, Tshibinda, xi.1951 (*P. C. Lefèvre*) (MRAC, Tervuren); 1 ♀, Lubumbashi, 10.iv.1939, at light (*H. J. Brédo*); 1 ♀, Kaniama, 8.iv.1939 (*Brédo*) (IRSNB, Brussels); 35 ♂, 44 ♀, Faradje, 29° 40' E, 3° 40' N, i.1913 (*Lang & Chapin*) (AMNH, New York); 1 ♂, Katanga, Lufira River, 31.viii.1907, 3500 ft (1050 m) (*Neave*); 1 ♂, 1 ♀, Katanga, Kambove, 4000–5000 ft (1200–1500 m), 23.iv.1907 and 21.vi.1907 (*Neave*); 1 ♂, Lualaba River, 24.v.1907, 2500–4000 ft (750–1200 m) (*Neave*); 1 ♀, SE. Katanga, 4000 ft (1200 m), i.xii.1907 (*Neave*); 1 ♀, Kando, 9.ix.1944 (BMNH, London). **Angola**: 1 ♂, Duque de Braganca Falls, 11–12.iii.1972, by sweeping (*BMNH Southern Africa Expedition*) (BMNH, London). **Zambia**: 4 ♂, 1 ♀, Upper Kalungwisi Valley, 4200 ft (1280 m), 11.ix.1908 (*S. A. Neave*); 1 ♂, Lower Kalungwisi Valley, 3500 ft (1050 m), in dense forest, 15.ix.1908 (*Neave*); 1 ♂, Chisinga Plateau, Kalungwisi District, 4500 ft (1350 m), 23.ix.1908 (*Neave*); 3 ♂, 2 ♀, same locality, 25.ix.1908 (*Neave*) (UM, Oxford). **Malawi**: 1 ♂, Mlanje Plateau, 6500 ft (2000 m), 18.xii.1913 (*S. A. Neave*); 1 ♀, Ft Jameson to Dowa, 4000–4500 ft (1200–1350 m), 4–9.x.1910 (*Neave*); 1 ♀, Kotakota, xi.1910 (*J. E. S. Old*) (BMNH, London).

Clavigralla zambiae sp. n.

(Figs 27–30)

Length: ♂, 8.2 mm ($n = 1$); ♀, 8.4 mm ($n = 1$). Similar to *C. leroyi* but smaller and body slightly more depressed. Known from only one specimen of each sex.

Antennifers strongly divergent, external apical processes porrect, triangular. Ratio of lengths of antennal segments I : II : III : IV in male 1.00 : 0.95 : 0.79 : 0.84, in female 1.00 : 0.97 : 0.74 :—(segment IV missing). Length of segment I divided by width of head including eyes in male 1.08, in female, 1.04. Ratio of lengths of rostral segments I : II : III : IV in male 1.00 : 0.87 : 0.49 : 0.78.

Pronotum (Fig. 27) moderately strongly declivent, posterolateral angles scarcely produced, posterolateral spines short, width across tips of spines divided by width of head including eyes in male 1.94, in female 2.10. Prescutellar spines absent. Dorsal ridge of metathoracic peritreme bilobed.

Abdominal sternites III–VII with posterolateral angles (Fig. 29) much less strongly produced than in *leroyi*. Paramere (Fig. 30) with teeth on inner side very unequal in length, apical tooth much the more prominent of the two. Conjunctiva (which could not be fully inflated) apparently similar to that of *leroyi*, having apical ventral lobes large and ornamented with small warts. Vesica with non-coiled portion as long as expanded conjunctiva and phallosome together. Spermatheca (Fig. 28) with duct near bulb following several short convolutions, then with short U-shaped portion.

Sculpture, pubescence and coloration similar to *leroyi*.

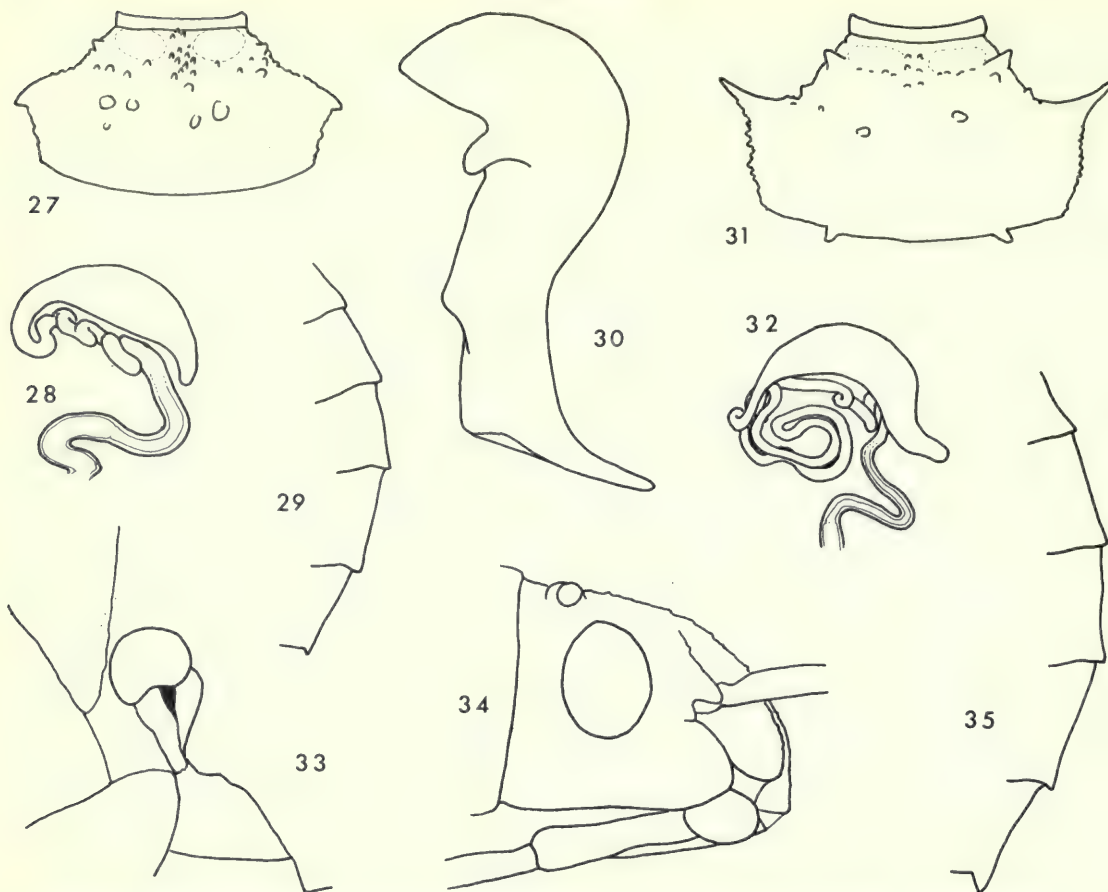
REMARKS. Distinguished from *C. leroyi* by the generally shorter antennae, narrower pronotum, longer vesica and different configuration of spermathecal duct.

DISTRIBUTION. So far known only from Zambia, a country with a large number of endemic species of very restricted distribution.

MATERIAL EXAMINED

Holotype ♀, **Zambia**: Mpika, 4700 ft (1450 m), 1904 (*F. H. Mellard*) (BMNH, London).

Paratype. **Zambia**: 1 ♂, Abercorn, x.1943 (*H. J. Brédo*) (IRSNB, Brussels).



Figs 27–35 *Clavigralla* species. (27) *zambiae*, pronotum of holotype ♂, dorsal view; (28) *zambiae*, spermatheca; (29) *zambiae*, lateral margins of abdominal sternites III–VII, ventral view; (30) *zambiae*, paramere of holotype, dorsal view; (31) *uelensis*, pronotum of ♀, dorsal view; (32) *uelensis*, spermatheca; (33) *uelensis*, left metathoracic peritreme, lateral view; (34) *uelensis*, head, right lateral view; (35) *uelensis*, lateral margins of abdominal sternites III–VII, ventral view.

***Clavigralla uelensis* (Schouteden) comb. n., stat. n.**

(Figs 31–35)

Acanthomia mixta var. *uelensis* Schouteden, 1938 : 291. LECTOTYPE ♀, ZAIRE (MRAC, Tervuren), here designated [examined].

Length: ♀, 9.6–9.7 mm, mean 9.6 mm ($n = 5$). Male unknown. Very similar in size, build and appearance to *C. leroyi*.

Antennifers strongly divergent, external apical processes large, triangular, porrect (Fig. 34). Ratio of lengths of antennal segments I : II : III : IV about 1.00 : 0.88 : 0.81 : 0.87; length of segment I divided by width of head including eyes 1.10–1.23, mean 1.15 ($n = 5$). Ratio of lengths of rostral segments I : II : III : IV about 1.00 : 0.84 : 0.54 : 0.77.

Pronotum (Fig. 31) with posterolateral angles moderately produced, posterolateral spines slender, directed obliquely forwards; width across apices of spines divided by width of head including eyes 2.27–2.57, mean 2.40 ($n = 5$). Metathoracic scent-gland peritreme with dorsal ridge entire, not bilobed (Fig. 33). Posterior femur with first subapical spine very short, much smaller than the second, or only one, long, subapical spine present, not preceded by smaller spines or tubercles and followed by a terminal series of four spines. Length of posterior tibia divided by that of posterior femur 0.86–0.92, mean 0.88 ($n = 3$).

Posterolateral angles of abdominal sternites III–VII (Fig. 35) less prominent than those of *leroyi*. Spermatheca (Fig. 32) with duct long and loosely convoluted, thin-walled portion very short.

REMARKS. Differs from all other species by the combination of the porrect external apical process of the antennifer and the entire, not bilobed, dorsal ridge of the metathoracic scent-gland peritreme. Otherwise, in size, shape, sculpture, pubescence and coloration this species is very similar to *leroyi*, and it was originally described as a variety of *mixta*, synonymized above with *leroyi*.

DISTRIBUTION. Central Africa.

MATERIAL EXAMINED

Acanthomia mixta var. *uelensis* Schouteden, lectotype ♀, **Zaire**: Dungu, xi.1919 (*P. van den Plas*) (MRAC Tervuren).

Zaire: 3 ♀, Dungu, xi.1919 (*P. van den Plas*) (paratypes of *Acanthomia mixta* var. *uelensis* Schouteden) (MRAC, Tervuren). **Central African Republic**: 1 ♀, Bambari, i.1964. (*G. Pierrard*) (MRAC, Tervuren).

The *elongata*-group

Antennifer with outer apical process long, deflexed; metathoracic peritreme with dorsal ridge entire; male genital capsule with tongue entire; lip of genital capsule filling posterior emargination in posterior view; pubescence of anterior, declivent area of pronotum almost uniform with that of posterior, horizontal part. Second valvula of ovipositor bearing at apex a usually bifid process. Pronotum with posterolateral angles usually strongly produced, tapering gradually into posterolateral spines.

Clavigralla hystrix Dallas **comb. rev.**

(Figs 36–42)

Clavigralla hystrix Dallas, 1852 : 512–513. Holotype ♂, **SIERRA LEONE** (BMNH, London) [examined].

Acanthomia hystrix (Dallas) Stål, 1873 : 83.

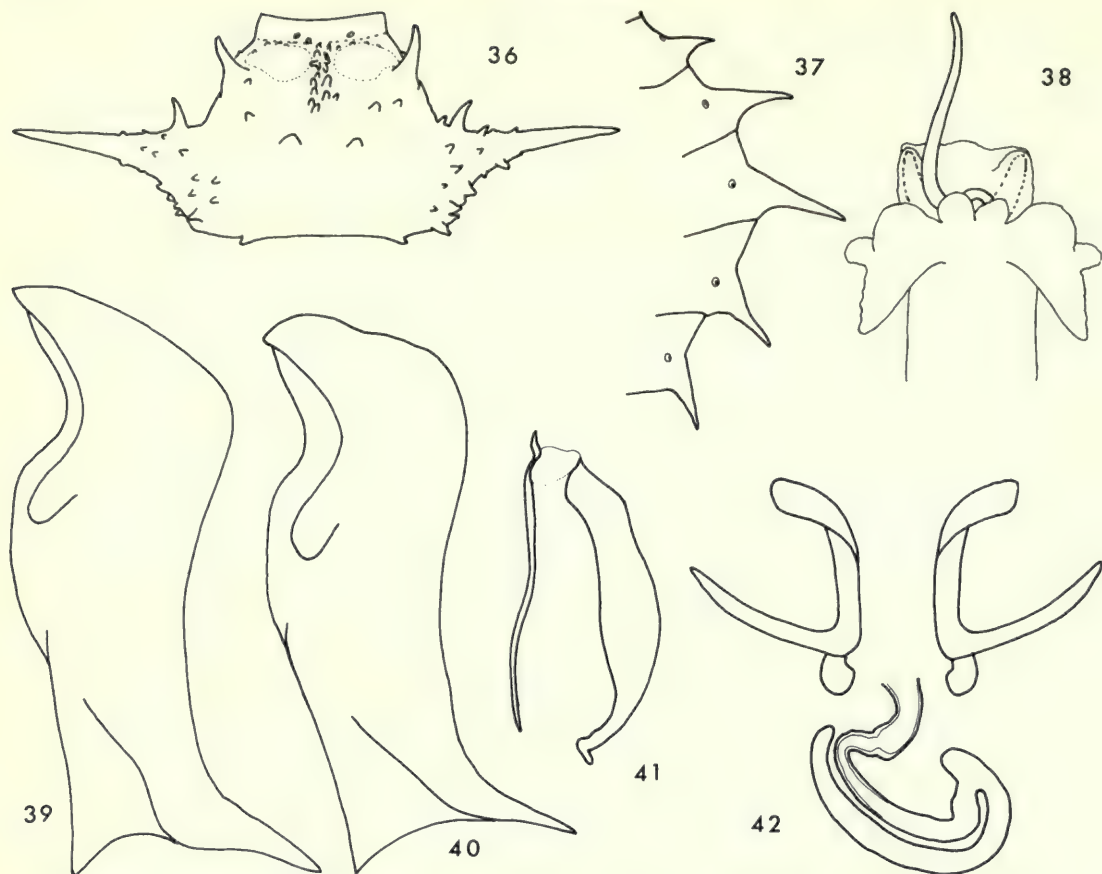
Length: ♂, 7.6–8.7 mm, mean 8.1 mm ($n = 28$); ♀, 8.3–9.8 mm, mean 9.0 mm ($n = 43$). Body robust, aspect very spinose, connexivum broad in middle, coloration very dark.

Antennifers rather strongly divergent. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.67 : 0.69 : 0.62, in female about 1.00 : 0.68 : 0.70 : 0.61. Segments I and III gently curved. Length of segment I divided by width of head including eyes in male 1.81–2.26, mean 2.01 ($n = 28$), in female 1.72–2.08, mean 1.92 ($n = 41$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.83 : 0.51 : 0.79.

Pronotum (Fig. 36) moderately strongly declivent, posterolateral spines drawn out into very long, slender spines, with several prominent spines in the vicinity of the posterolateral angles, disc with a semi-circle of about six spines, the most anterior spine on each side (close to middle of lateral margins) very much more prominent than the rest, spines at prescutellar angles small. Width of pronotum across apices of posterolateral spines divided by width of head including eyes in male 2.78–3.68, mean 3.32 ($n = 23$), in female 3.10–3.95, mean 3.51 ($n = 35$). Scutellum strongly convex. Corium with apex slightly produced, at rest reaching to level of middle of laterotergite V. Anterior and intermediate femora each with one small subapical spine beneath, or that of intermediate femora absent, or, rarely, anterior femur with a second subapical spine proximal to and much smaller than the other. Posterior femur with two major spines, the more proximal about half as long as the other and separated from it by a row of about four small spines, apical series of four spines present. Posterior tibia gently bowed near base, its length divided by that of posterior femur in both sexes 0.85–0.97, mean 0.90 ($n = 68$).

Abdominal sternites III–VII with posterolateral angles produced into long, stout spines (Fig. 37). Male genital capsule with lip broad, tongue rather short. Paramere (Figs 39, 40) with apical margin weakly convex to straight and slightly emarginate in middle, varying slightly in the angle it forms with axis of shaft. Conjunctiva (Fig. 38) with distal ventrolateral lobes large, apical ventral lobes of moderate size, distal dorsolateral lobes obsolete, dorsomedian and distal dorsomedian lobes low. Female sternite VII deeply cleft. Second valvula (Fig. 41) with a single, narrow process at apex. Spermatheca (Fig. 42) with bulb narrow and duct short. Sclerites of dorsal wall of gynatrium (Fig. 42) with median, longitudinal arms broad, strongly divergent posteriorly.

Head granulate throughout, antennal segments I–III sparsely and minutely granulate. Pronotum in posterior half and all pleura coarsely punctate, pleura with a few granules or short, blunt spines. Scutellum very coarsely granulate. Clavus and corium coarsely and rather sparsely punctate, veins in basal two-thirds



Figs 36–42 *Clavigralla hystrix*. (36) pronotum, dorsal view; (37) lateral margins of abdominal sternites III–VII, ventral view; (38) conjunctiva and vesica, ventral view; (39) paramere, dorsal view, Uganda; (40) same, Zaire; (41) left second valvula, medial view; (42) sclerites of dorsal wall of gynatrium and spermatheca, dorsal view.

of corium granulate. Femora and tibiae almost obsoletely granulate. Thoracic and abdominal sterna impunctate, abdominal sternite VII shallowly and sparsely rastrate.

Head, antennae, rostrum and legs with short, decumbent, golden hairs and short, semierect white hairs, the decumbent pubescence dense on head, sparse elsewhere, semierect pubescence longer on tibiae and tarsi. Pronotum and scutellum with short, dense, decumbent, golden pubescence and fairly short, erect, sparse, brown pubescence. Clavus and corium with short, decumbent, golden pubescence and short, crisped, semidecumbent, white pubescence intermingled. Thoracic pleura, abdominal sternites and laterotergites with short, dense, decumbent, golden pubescence and short, dense, semidecumbent, white pubescence intermingled. Thoracic sterna with decumbent, golden pubescence only.

Colour dark brown to piceous. Antennal segments I–III each with a more or less obscure pale annulus distad of middle, that on segment II the most distinct of the three. Antennal segment IV ivory-white, not at all to heavily infusate. Tibiae each with two pale brown to stramineous annuli, the distal annulus frequently continuous to apex of tibia. First segment of all tarsi stramineous above except at extreme base and apex. Posterior femur with a pale annulus basad of middle. Midline of anterior half of pronotum broadly darker than ground colour. Abdominal sternites and laterotergites with obscurely paler areas. Corium stramineous, heavily spotted with brown and with a more extensive patch of brown on disc. Membrane dark brown with scattered white spots and a white crescent in proximal angle. Distal margin of corium stramineous, forming a large, pale capital A together with the white crescent on membrane when elytra are at rest.

REMARKS. This species varies in the length of its spines and appendages and to a lesser degree in colour in different parts of its range. The greatest development of the pronotal spines is found in the centre of its range, in Zaire. Means of the ratio pronotal width/head width in various parts of the range of the species are as follows: West Africa (Sierra Leone to Nigeria): ♂, 3.25; ♀, 3.31; Cameroun: ♂, 3.38; ♀, 3.61; Zaire: ♂, 3.44; ♀, 3.67; East Africa (Uganda and Kenya): ♂, not available; ♀, 3.19. The ratio length of antennal segment I/head width decreases from west to east as follows: West Africa: ♂, 2.11; ♀, 1.99; Cameroun: ♂, 1.97; ♀, 1.95; Zaire: ♂, 1.89; ♀, 1.84; East Africa: ♂, 1.87; ♀, 1.74. Antennal segments II and III maintain their length relationship with segment I throughout the range of the species but segment IV in both sexes averages 0.66 times the length of segment I in Zaire and 0.60 elsewhere. Antennal segment IV is more heavily infusate in examples from Zaire and East Africa than in those from Cameroun and West Africa and the more distal pale annulus of the tibiae is more often continuous to the apex of each tibia in Zaire and East Africa than in Cameroun and West Africa. Paramere shape does not appear to vary systematically from place to place. The egg is figured by Cobben (1968 : 97, fig. 85).

DISTRIBUTION. Equatorial Africa, from Sierra Leone to Uganda, in forest areas.

MATERIAL EXAMINED

Clavigralla hystrix Dallas, holotype ♂, **Sierra Leone** (*D. J. Morgan*) (BMNH, London).

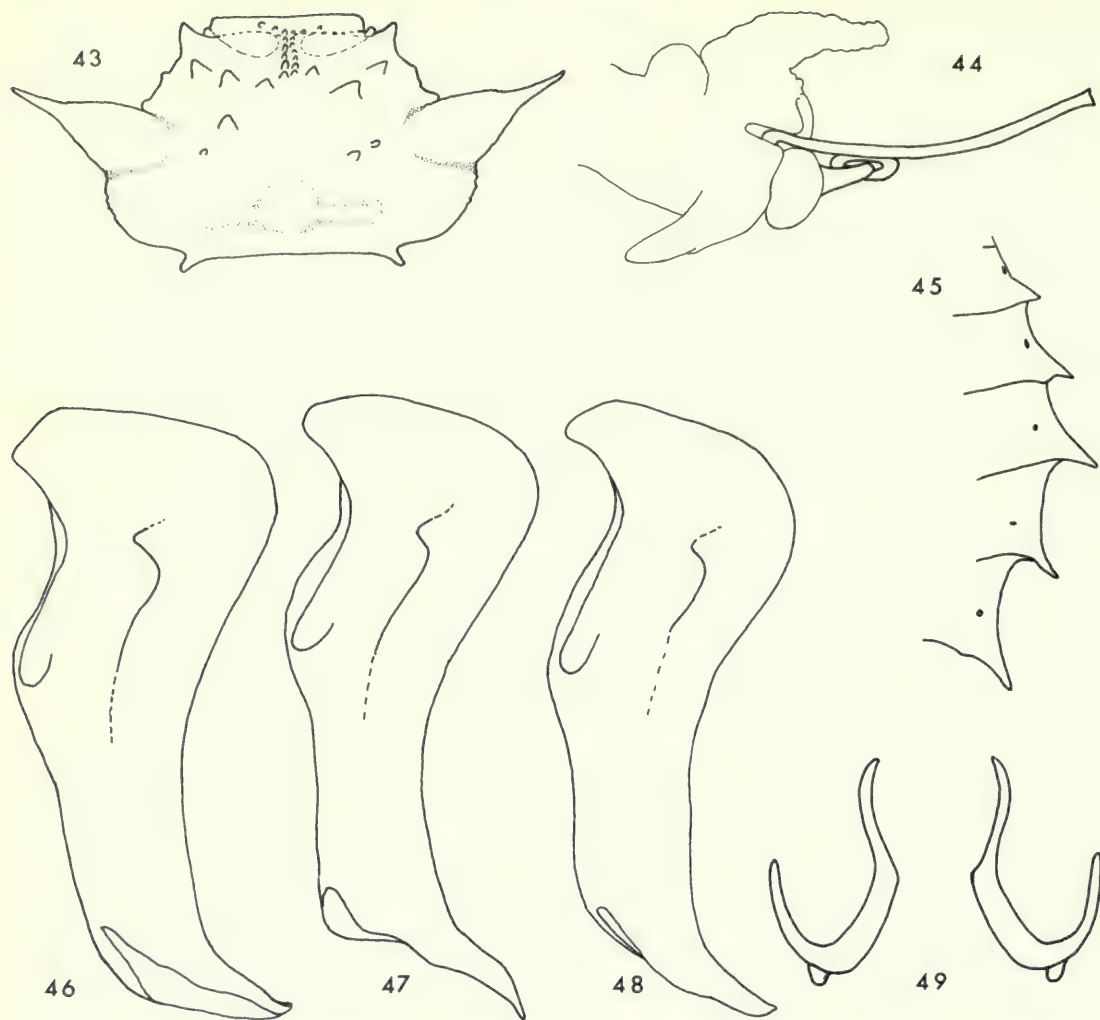
Sierra Leone: 1 ♂, Njala, viii.1928 (*E. Hargreaves*) (BMNH, London). **Liberia:** 1 ♀, 32 km S. of Voinjama, 13.viii.1966 (*E. S. Ross, K. Lorenz*) (CAS, San Francisco). **Ivory Coast:** 1 ♂, Adiopodoumé, iv–v.1964 (*R. H. Cobben*) (BMNH, London); 1 ♂, Akoupe, 25 km N. of Abidjan, x.1961 (*J. Decelle*); 1 ♀, Akoupe, v.1961 (*Decelle*); 2 ♂, 5 ♀, Mouyassoué, Aboisso, xii.1962 (*Decelle*) (MRAC, Tervuren). **Ghana:** 1 ♀, 'Owealé Akem, Aschanti-Guinée' (IRSNB, Brussels); 1 ♂, 1 ♀, Aburi (*A. R. Gould*); 1 ♀, ENE. of Tafo, 26.iii.1948, on herbage (BMNH, London); 1 ♀, Tafo, 14.x.1966, on cocoa, by pyrethrum knock-down (*R. Kumar*); 1 ♀, Adukrom, 14.x.1967 (*D. Leston*); 1 ♂, 1 ♀, Kukurantumi, 13.i.1968, on Leguminosae (*Leston*); 3 ♂, Tafo, 13.v.1966, 3.i.1967, 11.i.1968 (*Kumar*); 1 ♂, Mt Atewa, 22.x.1967, in secondary forest (*Leston*); 1 ♂, Adonkwanta, 1.viii.1967 (*Leston*); 1 ♂, Volta River Forest Reserve, 5.ix.1965 (*Leston*) (UG, Legon). **Togo:** 1 ♂, Missahoué, 650 m, vi.1963 (*Mme Y. Schach*) (MRAC, Tervuren). **Nigeria:** 1 ♀, Old Calab[ar] (*J. Gray*) (BMNH, London); 1 ♀, Lagos Colony, Isheri, 9–10.iv.1949 (*Borys Malkin*); 1 ♀, Oyo Prov., Ogbomosho, 12.xii.1948 (*Malkin*) (CAS, San Francisco). **Cameroun:** 1 ♂, 4 ♀, Lolodorf (*G. Schwab*); 4 ♀, Metet (*Schwab*) (AMNH, New York); 1 ♀, Mukonje Farm (*F. Rohde*) (IRSNB, Brussels); 1 ♂, 3 ♀, Nkolbisson, Nyong-Sanaga, x.1963 (*L. G. Segers*) (MRAC, Tervuren); 1 ♂, 1 ♀, Escalera; 2 ♀, Batouri District, 3° 45' N, 13° 45' E, 750 m, 1.v–6.vi.1935 (*F. G. Merfield*) (BMNH, London); 9 ♂, 8 ♀, 1 V instar nymph, Victoria Div., Mabete, 24.v–7.vi.1949 (*B. Malkin*); 3 ♂, Victoria, Mabete, 15.vi.1949 (*Malkin*); 11 ♂, 10 ♀, 1 V instar nymph, Victoria Div., Mabeta, vii–viii.1949 (*S. Tita*); 1 ♂, Victoria Div., Muyuka, 24–29.vi.1949 (*B. Malkin*); 4 ♂, 3 ♀, Sasse, Buea, iv–v.1951 [no collector stated]; 1 ♀, Sasse, Sappo, 22–26.ii.1952 (*S. Tita*); 1 ♂, 2 ♀, Sappo, near Buea, iii.1951 (*S. Tita*); 1 ♂, 2 ♀, Mamfe, 22–24.i.1949 (*B. Malkin*) (CAS, San Francisco). **Zaire:** 1 ♂, Luhoho River, Bunyakiri, 1100 m, 6.ix.1957 (*E. S. Ross, R. E. Leech*) (CAS, San Francisco); 1 ♂, 1 ♀, Ituri Forest, 40 miles (64 km) NNE. of Beni, 3000 ft (900 m), 12–10.ix.1959 [sic], in indigenous forest (*Cambridge E. African Exped.*), 1 ♀, Mt Hoyo, 1° 10' N, 30° 0' E, 3000 ft (900 m), 14–16.ix.1959, in forest clearings (*Cambridge Exped.*) (BMNH, London); 1 ♂, 1 ♀, Medje, 2° 25' N, 27° 15' E, vi.1914 (*Lang & Chapin*); 1 ♂, Medje, vii.1910 (*Lang & Chapin*); 1 ♀, Kisangani (as Stanleyville), iii.1915 (*Lang & Chapin*) (AMNH, New York), 2 ♂, Bambesa, 17.vi.1937, 26.i.1939 (*J. Vrydagh*); 2 ♀, Bambesa, 29.vi.1937, 20.xii.1939 (*Vrydagh*); 1 ♂, Bukolela, 1938 (*R. Massart*); 3 ♀, Ngowa, 16.xi.1938 (*R. P. J. Mertens*); 1 ♀, Wenga Ifomi (*E. Quineaux*); 1 ♀, Kisangani (*J. Muller*) (IRSNB, Brussels); 1 ♂, Kasongo, R. Lumami, ii.1960 (*P. L. G. Benoit*); 1 ♂, Kasongo, Mufala, xi.1959–i.1960 (*Benoit*); 1 ♂, Equateur, Bokuma, vii.1952 (*R. P. Lootens*); 1 ♀, Kivu, Kavumu to Kabunga, km 82, viii.1951 (*H. Bomans*); 1 ♀, Kivu, Lukando (Bunyakiri) 1959–1960 (*J. Hecq*) (MRAC, Tervuren). **Uganda:** 1 ♂, Entebbe, 16.xii.1912 (*C. C. Gowdey*); 1 ♀, Entebbe, 12.ix.1912 (*Gowdey*) (BMNH, London); 1 ♂, 1 ♀, Mulange, xi.1922 (*R. Summer*) (PPRI, Pretoria). **Kenya:** 1 ♀, Mabira F. (*A. F. J. Gedy*) (BMNH, London). **Angola:** 1 ♀, Carmona, Faz. Bambi, ii.1972 (*J. A. Quarteau*) (Duarte coll.).

Clavigralla hystricodes Stål comb. rev.

(Figs 43–49)

Clavigralla hystricodes Stål, 1866 : 109. LECTOTYPE ♀, SIERRA LEONE (NR, Stockholm), here designated [examined].

Acanthomia hystricodes (Stål) Stål, 1873 : 83.



Figs 43-49 *Clavigralla hystricodes*. (43) pronotum, dorsal view; (44) conjunctiva and vesica, left lateral view; (45) lateral margins of ♂ abdominal sternites III-VII, ventral view; (46) paramere, dorsal view, Sierra Leone; (47) same, Nigeria; (48) same, Tanzania; (49) sclerites of dorsal wall of gynatrium, dorsal view.

Length: ♂, 8.6-9.8 mm, mean 9.2 mm ($n = 21$); ♀, 9.2-10.8 mm, mean 9.8 mm ($n = 37$). Body robust, coloration generally piceous.

Antennifers strongly divergent. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.76 : 0.80 : 0.75, in ♀ about 1.00 : 0.76 : 0.79 : 0.73, segments II and III straight. Length of segment I divided by width of head including eyes in male 1.25-1.49, mean 1.36 ($n = 23$), in female 1.18-1.46, mean 1.33 ($n = 37$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.83 : 0.62 : 0.90.

Pronotum (Fig. 43) strongly declivent, spines of disc short, broad, irregularly distributed. Width of pronotum across apices of posterolateral spines divided by width of head including eyes in male 2.63-3.07, mean 2.88 ($n = 15$), in female 2.63-3.25, mean 2.97 ($n = 31$). Scutellum strongly convex. Spines on femora as in *C. hystrix* except that anterior femur usually bears two subapical spines (usually one in *hystrix*). Posterior tibia weakly angled, rather than curved, near base, its length divided by that of posterior femur in both sexes 0.74-0.84, mean 0.80 ($n = 57$). Corium with apex produced, at rest reaching to level of suture between laterotergites V and VI.

Abdominal sternites III–VII with posterolateral angles strongly produced (Fig. 45). Male genital capsule with lip moderately broad, tongue rather narrow. Paramere (Figs 46–48) with apical margin weakly to rather strongly convex, making a variable angle with axis of shaft. Conjunctiva (Fig. 44) similar to that of *C. hystrix* but with distal dorsomedian lobe larger. Female sternite VII deeply cleft. Spermatheca with bulb narrow, duct short. Sclerites of wall of gynatrium (Fig. 49) slender, apically slightly convergent. Second valvula with apex broad, bearing apically a bifid process similar to that of *C. elongata* (cf. Fig. 57).

Sculpture and pubescence as in *C. hystrix* except that thoracic pleura lack spines and large granules.

Colour piceous, with pale brown or stramineous markings. Head with a diagonal pale line running from inner dorsal angle of each eye towards posterior margin of head behind ocellus. Antennal segments I, II and III each with a conspicuous pale stramineous annulus at base and another about two-thirds of the way towards apex, IV brown with basal annulus pale stramineous. Pronotum with granules along midline of declivent area black. Thoracic pleura reddish piceous, with black and pale rufous patches. Clavus and corium pale brown, corium with some spots near anterior margin and a large area near apical margin piceous to black, a line along posterior two-thirds of apical margin and some large spots on and near anterior margin stramineous. Membrane dark brown with extensive piceous area on disc and numerous obscure paler spots. Connexivum piceous, laterotergites III–VII each with a narrow, transverse band in anterior half stramineous. Most lateral one-quarter of abdominal sternites on each side dark, rufous brown with a stramineous spot on each margin adjacent to the pale band on the corresponding laterotergite, remaining area of each sternite stramineous with confused, rufous brown and piceous markings. Femora dark rufous brown with extensive area near base and some mottling near apex stramineous. Tibiae piceous, each with a distinct, stramineous annulus in basal and apical half.

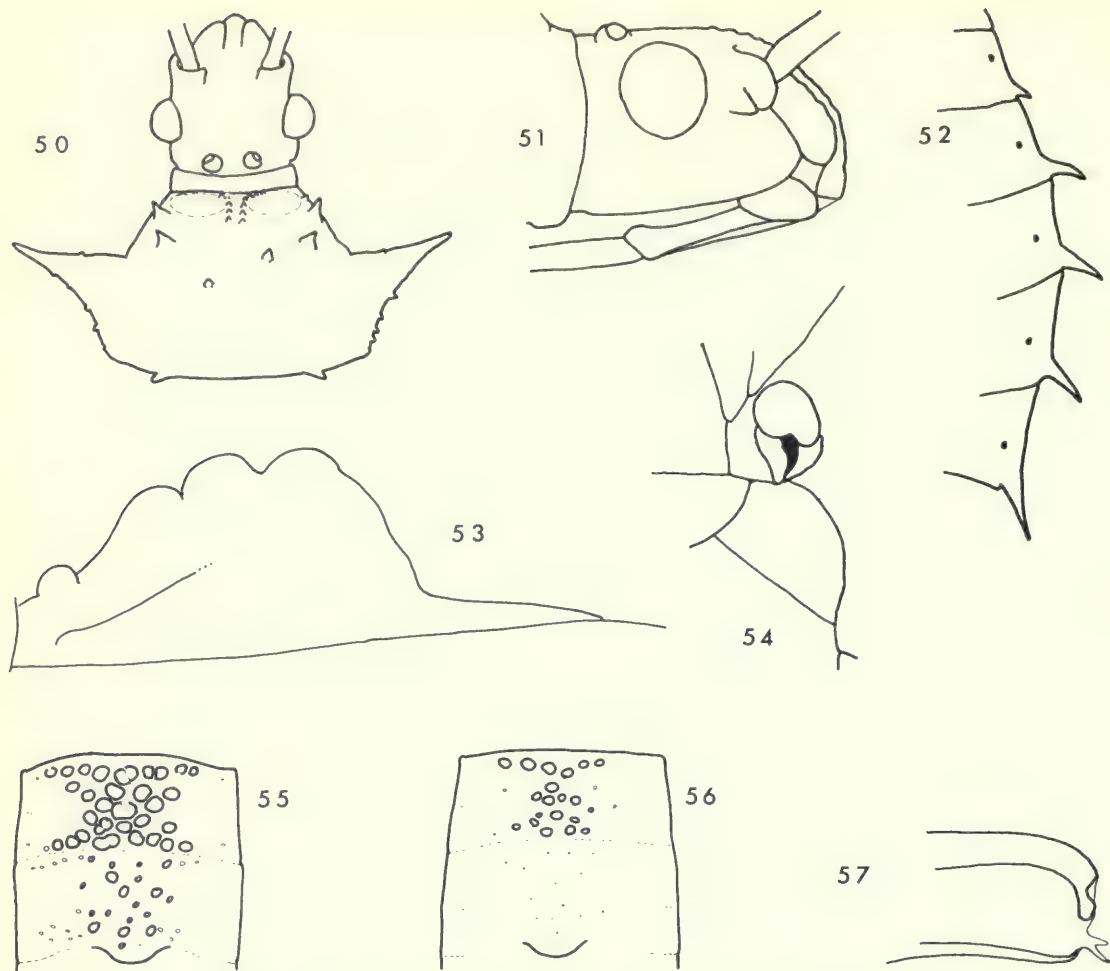
REMARKS. West African (Sierra Leone to Cameroun) individuals were found on average to have longer pronotal spines and a longer antennal segment I than the Central and East African individuals. The ratio width of pronotum/width of head in West African individuals was: male, 2.92–3.07, mean 3.00 ($n = 5$); female, 2.93–3.31, mean 3.02 ($n = 7$) and the ratio length of antennal segment I/head width was: male, 1.37–1.49, mean 1.44 ($n = 5$); female, 1.34–1.46, mean 1.40 ($n = 8$). The single female seen from South Africa was the largest at 10.75 mm in length (next longest specimen 10.4 mm) and had the lowest value, 1.18 for the ratio length of antennal segment I/head width (next lowest value 1.20 in individuals from Malawi and Zaire). In males from West and Central Africa the angle between the apical and lateral margins of the paramere is more narrowly rounded (Figs 46, 47) than in individuals from East Africa (Fig. 48). This does not of itself seem to justify taxonomic separation of the populations and no males were available from the most southerly part of the range or from Uganda, so that at present it is not possible to interpret the pattern of variation in full. Feeds on pulse crops in East Africa (Bohlen, 1973 : 95). A coloured figure of the adult is given by Bohlen (1973 : 33, fig. 159).

DISTRIBUTION. Tropical Africa, extending westward to Sierra Leone, eastward to Uganda and Tanzania and southward to the Transvaal.

MATERIAL EXAMINED

Clavigralla hystricodes Stål, lectotype ♀, **Sierra Leone** (no other data) (NR, Stockholm).

Sierra Leone: 1 ♂, Njala, 15.x.1960, on *Homalium angustifolium* Smith (Flacourtiaceae) (*M. P. Rushton*) (BMNH, London). **Ivory Coast:** 1 ♀, Daloa, Zepreghe, i.1963 (*J. Decelle*) (MRAC, Tervuren). **Ghana:** 3 ♂, Tafo, 14.iv.1966, 23.iv.1967, 13.ii.1967, the first two by pyrethrum knockdown from cocoa (*R. Kumar*); 1 ♀, Kade, cocoa farm, 22.viii.1969 (*G. Benson*) (UG, Legon). **Nigeria:** 2 ♂, 2 ♀, Calabar, 3–6.xi.1955 (*Bechyne, Exped. Mus. G. Frey, Nigeria-Kamerun*) (BMNH, London); 1 ♀, Ibadan, 22.iii.1949 (*B. Malkin*) (CAS, San Francisco). **Cameroun:** 2 ♀, Nyong-Sanaga, Nkolbisson, x.1963 (*L. G. Segers*) (MRAC, Tervuren). **Zaire:** 1 ♀, Lubumbashi, 11.ix.1931 (*Miss A. Mackie*) (BMNH, London); 46 ♂, 39 ♀, 1 ex without abdomen, Faradje, 3° 40' N, 29° 40' E, i.1913 (*Lang & Chapin*) (AMNH, New York); 2 ♂, Kasongo Terr., Lumani River, ii.1960 (*P. L. G. Benoit*); 1 ♂, Eala, 29.x.1938 (*G. Couteaux*); 1 ♀, Equateur, Bokuma, vii.1952 (*R. P. Lootens*); 1 ♀, Sankuru, M'Pemba Zeo (Gandajika), 1960 (*R. Maréchal*) (MRAC, Tervuren); 2 ♂, Ngowa, 9.v.1939 (*R. P. J. Mertens*); 6 ♀, Ngowa, 7–27.iv.1939, 5–16.vi.1939 (*Mertens*); 2 ♂, 2 ♀, Mpese, ii–iv.1937, v–vi.1937 (*R. P. J. Cooreman*); 2 ♂, 1 ♀, Kibangula, ii.1955, 1956 (*L. Henry*); 1 ♂, Malongi, vi.1943 (*H. J. Brédo*); 1 ♀, Wenga Ifomi (*E. Quineaux*); 1 ♀, Kongolo (*Mad. Passau*); 1 ♀, Botuna, Bokungu, 1950 (*M. Boel*); 1 ♀, Libenge, 12.x.1947 (*R. Cremer, M. Neuman*) (IRSNB, Brussels). **Uganda:** 1 ♀, Entebbe, x.1912 (*C. C. Gowley*) (BMNH, London). **Tanzania:** 1 ♀, Morogoro, 20.vi.1922, on legumes (*A. H. Ritchie*); 3 ♂, 1 ♀, Morogoro, 7–8.v.1973, on cow pea (*Vigna catjang* Endlicher); 1 ♂,



Figs 50-57 *Clavigralla elongata*. (50) head and pronotum, dorsal view; (51) head, right lateral view; (52) lateral margins of ♀ abdominal sternites III-VII, ventral view; (53) scutellum, left lateral view; (54) left metathoracic peritreme, lateral view; (55) abdominal tergites III and IV, ♀, South Africa; (56) same, ♀, Uganda; (57) left second valvula of ovipositor, lateral view.

Ilonga, 12.vi.1968, on grams (*Phaseolus*) (C. J. Thomas); 1 ♀, Ilonga, 26.ii.1968, on cow pea (Thomas); 1 ♀, Ilonga, 24.iv.1968, on cow pea (Thomas) (BMNH, London). **Malawi**: 2 ♀, vii-viii.1895 (A. Whyte) (BMNH, London). **Rhodesia**: 1 ♀, Cashel, xii.1947 (NM, Bulawayo). **South Africa**: 1 ♀, Transvaal, Marieps Mountain, iv.1932 (G. van Son) (TM, Pretoria).

***Clavigralla elongata* Signoret sp. rev.**

(Figs 50-65)

[*Zicca horrida* (Germar) Herrich-Schaeffer, 1851 : 271, pl. 320, fig. 991. Misidentification.]

Clavigralla elongata Signoret, 1860 : 944. LECTOTYPE ♂, TANZANIA (NM, Vienna), here designated [examined]. [Synonymized with *Clavigralla horrida* (Germar) sensu Herrich-Schaeffer by Stål, 1866 : 108.]

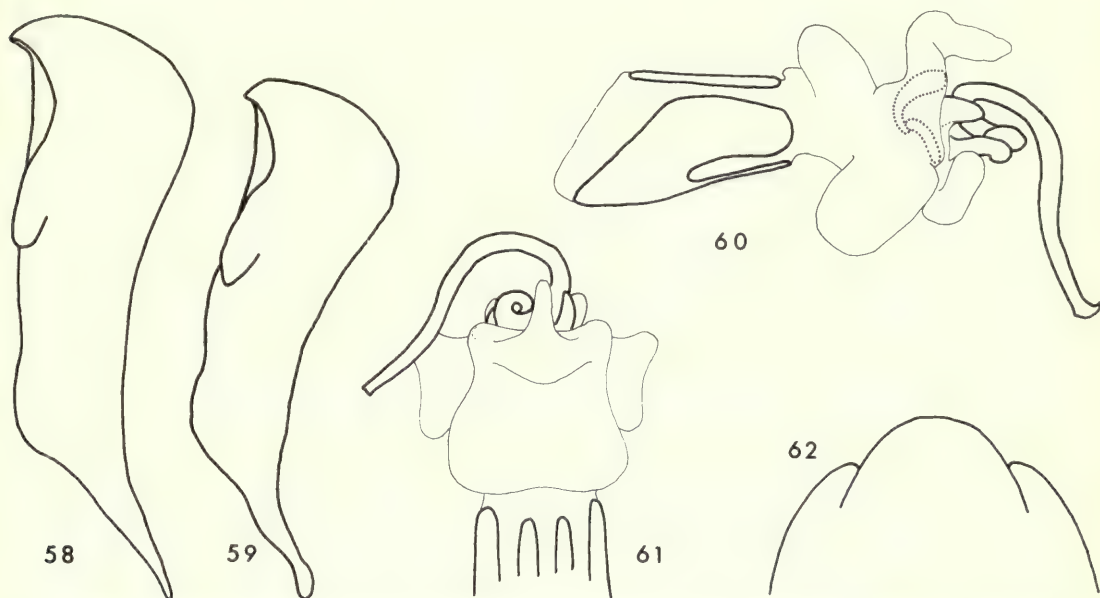
Clavigralla flavipennis Signoret, 1860 : 945. LECTOTYPE ♀, MADAGASCAR (NM, Vienna), here designated [examined]. [Synonymized with *Clavigralla horrida* (Germar) sensu Herrich-Schaeffer by Stål, 1866 : 108.]

[*Clavigralla horrida* (Germar) Stål, 1866 : 108. Misidentification.]

[*Acanthomia horrida* (Germar) Stål, 1873 : 83. Misidentification.]

Length: ♂, 8.3–9.6 mm, mean 9.1 mm ($n = 23$); ♀, 8.3–10.8 mm, mean 9.6 mm ($n = 26$). Form elongate-oblong, aspect spinose, coloration greyish yellow.

Head (Figs 50, 51) about as long as wide, antennifers moderately divergent. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.85 : 0.82 : 0.81, in female about 1.00 : 0.85 : 0.82 : 0.80. Length of antennal segment I divided by width of head including eyes in male 1.29–1.72, mean 1.49 ($n = 23$), in female 1.18–1.59, mean 1.42 ($n = 24$). Ratio of lengths of rostral segments I : II : III : IV in male about 1.00 : 0.90 : 0.58 : 0.89, in female about 1.00 : 0.87 : 0.58 : 0.88.

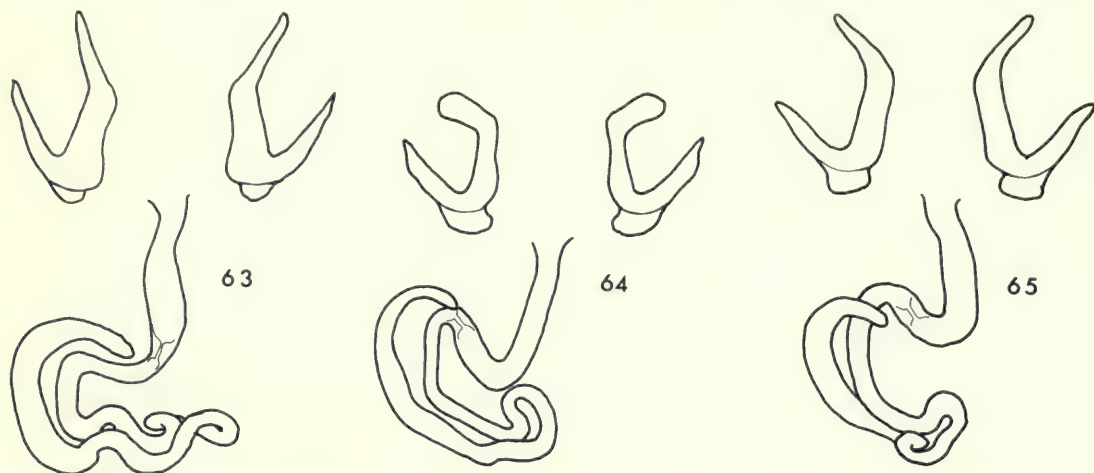


Figs 58–62 *Clavigralla elongata*. (58) left paramere, dorsal view, Tanzania; (59) same, Madagascar; (60) phallosome, expanded conjunctiva and vesica, left lateral view; (61) same, dorsal view; (62) lip of ♂ genital capsule, posteroventral view.

Pronotum (Fig. 50) strongly declivent, disc typically with an often irregular semicircle of about six large, spine-like tubercles, the anterior pair, situated close to mid-point of lateral margins, being only slightly longer and stouter than the pair behind them. Posterolateral angles of pronotum strongly produced, slightly elevated and directed slightly anteriorly, each terminating in a slender, very gently curved spine. Width of pronotum across apices of posterolateral spines divided by width of head including eyes rather variable between populations, in male 2.56–3.27, mean 2.84 ($n = 23$), in female 2.57–3.27, mean 2.91 ($n = 25$). Scutellum (Fig. 53) strongly convex, without outstanding spines or tubercles. Dorsal ridge of metathoracic peritreme (Fig. 54) entire, reniform. Corium with apex narrowly produced, at rest reaching posteriorly to about level of apex of laterotergite VI. Anterior and intermediate femora each with a single, moderate sized, subapical spine ventrally, posterior femur typically with two major spines with four minor spines between them and an apical series of four spines, rarely with additional major spines proximal to the main pair, number of small spines between main pair rather variable. Posterior tibia almost straight, its length divided by that of posterior femur in both sexes 0.76–0.88, mean 0.83 ($n = 49$).

Abdominal sternites III–VII (Fig. 52) each with a slender spine at posterolateral angles directed obliquely posteriad. Male genital capsule with lip (Fig. 62) narrowly rounded, tongue acutely pointed, entire. Paramere (Figs 58, 59) with blade rather broad, apex with a small tooth, basal tooth pointing back along shaft. Conjunctiva (Figs 60, 61) without ventral or distal dorsolateral lobes, dorsomedian lobe large, distal dorsomedian lobe small with narrow, distally projecting, finger-like, apical process, ventral apical and distal ventrolateral lobes well developed. Vesica long, left sclerite protecting base of vesica slightly longer than right, apices of both sclerites simple. Wings and straps of ejaculatory reservoir complex long.

Female sternum VII cleft for about one-third of its median length. Spermatheca (Fig. 63) typically with bulb narrow, duct convoluted for a distance equal to about twice the length of bulb, then simply curved for a distance about equal to length of bulb, then wider and thinner walled for about the same distance before entering gynatrial sac. Sclerites of wall of gynatrium with apices of median arms abruptly diverging, usually slender (Fig. 63). Apex of second valvula (Fig. 57) bearing a bifid process.



Figs 63–65 *Clavigralla elongata*. (63) spermatheca and sclerites of dorsal wall of gynatrium, dorsal view, South Africa; (64) same, Canary Is.; (65) same, Cape Verde Is.

Head weakly granulate throughout, more strongly on frons. Antennae with segment I minutely and sparsely granulate, other segments almost smooth. Pronotum with posterior half of disc punctate, lateral margins and area around posterolateral angles granulate to tuberculate. Scutellum granulate. Thoracic pleura punctate and very sparsely granulate, thoracic sterna minutely roughened. Femora weakly and sparsely granulate, very obscurely punctate in apical half, tibiae minutely granulate. Clavus and much of corium strongly punctate, disc of corium more weakly punctate, apex impunctate. Abdominal sternites and laterotergites minutely rough, lacking macrosculpture. Abdominal tergites I and II transversely coarsely striate; III and IV with a few large pores, very few pores of intermediate size and some small or minute ones, the large pores restricted to the midline of tergite III and its anterior and posterior borders and sometimes also to midline of segment IV (Fig. 55), from which they are often entirely lacking (Fig. 56), if present on segment IV then distributed along its whole length and concentrated near anterior margin; puncturation of remaining abdominal tergites small or minute.

Head with short, decumbent, silvery pubescence and a few, suberect colourless or pale brown hairs, the latter restricted to dorsal surface, especially frons. All antennal segments with very short, decumbent, silvery much sparser pubescence, on segments II and III than on I and lacking on specialized sensory area of IV, and short, suberect, pale hairs. Pronotum with silvery, decumbent pubescence anteriorly and very sparse, decumbent, golden pubescence posteriorly, with moderately long, pale brown to colourless, erect pubescence throughout. Scutellum with short, decumbent, silvery, tomentose pubescence mixed with long, erect, pale brown pubescence which becomes paler towards lateral margins. Thoracic pleura with silvery, decumbent pubescence and longer, sparse, semierect colourless hairs; thoracic sterna with short, decumbent, silvery white hairs. Legs with short, pale brown, suberect hairs and short, silvery, decumbent hairs throughout, the latter type denser on femora which also bear a few long, erect hairs ventrally. Clavus and corium with short, semidecumbent, pale brown to colourless pubescence and sparse, scarcely visible, decumbent, silvery pubescence. Abdominal sterna with short, suberect to semidecumbent, colourless hairs and decumbent, silvery pubescence. Decumbent, silvery pubescence of thoracic pleura and outer thirds of abdominal sterna organized in some places into longitudinal or oblique streaks of denser, tomentose or slightly tufted hairs.

Head, thorax and femora slightly ferruginous brown, with ventral surface of head, thoracic sterna and apices of pronotal spines piceous. Antennae stramineous, segments I and IV darker. Tibiae stramineous, each with a narrow, basal annulus and sometimes a similar, apical annulus brown. Clavus, corium, tarsi

and a few spots on apical halves of femora stramineous with a slightly greyish tinge. Membrane of hemelytra colourless, narrowly pigmented brown along course of veins, pigment interrupted in places. Abdominal sternites ferrugineous brown with middle, especially of more anterior ones, more or less broadly piceous and a slightly oblique line on each side about one-third of the way from lateral margin to midline stramineous; a stramineous spot also present on lateral margin of each. Laterotergites ferrugineous brown, III–VII each with a large, stramineous spot adjacent to the similarly coloured spot on lateral margin of corresponding sternite. Abdominal tergites I and II piceous, III–VII orange, III and lateral areas of IV–VI more or less heavily infuscate to piceous, centre of VI and VII occasionally with piceous markings.

REMARKS. There is considerable variation in the degree of puncturation of the abdominal terga and in the number of spines on the pronotal disc but the general pattern of both punctures and spines is characteristic. There are isolated populations of this species in the Canary Islands and the Cape Verde Islands. Morphometric data for specimens from these areas are not included in the description above. On average, the antennae are shorter than in the mainland population. In two females seen from the Canary Islands the length of antennal segment I divided by the width of the head including eyes was 1.18 and 1.30. In two males from the Cape Verde Islands this ratio was 1.37 and 1.43 and in four females from the same area it ranged from 1.31 to 1.39, mean 1.36. In females from both island groups the convoluted part of the duct of the spermatheca is shorter than in the mainland population (Figs 64, 65; compare Fig. 63). In both females from the Canary Islands the sclerites of the dorsal wall of the gynatrium (Fig. 64) were unusually short and much thicker apically than in the mainland form (Fig. 63), but this was not true of specimens from the Cape Verde Islands (Fig. 65). Many specimens from the Cape Verde Islands bear three major subapical spines on the posterior femur. Such a specimen is figured by Lindberg (1958 : 33) who records the species from the following islands in the group: Santo Antão, São Vicente, São Nicolau, São Tiago, Fogo, Brava and Ilheus de Rombo. Because these populations differ somewhat from the mainland form recent introduction seems unlikely. The nearest localities to these islands where *C. elongata* is now found are São Tomé, Príncipe and Zaire. Perhaps the species was once present in the intervening area of West Africa and has now been displaced by *C. shadabi* which appears from the recorded host-plant data to occupy a similar niche. The form from the Canary Islands may have been isolated long enough to have acquired specific status, to judge from the differences in the sclerites of the wall of the gynatrium when compared with material from other parts of the range of *C. elongata*. Unfortunately, no male was available from the Canary Islands and the question of the status of this population must remain unresolved for the present.

This is the species known to East African agricultural entomologists as *Acanthomia horrida*. It is a pest of many cultivated Leguminosae, in particular *Dolichos lablab* Linnaeus, *Cajanus cajan* Linnaeus (Millspaugh), *Phaseolus* spp. and *Vigna* spp. Natural enemies include *Mormonomyia argentifrons* Walker, a tachinid fly parasitic on the adult (Materu, 1971 : 376) and guineafowl. A scelionid (Hymenoptera), *Hadronotus gnidus* Nixon, parasitized a low percentage of eggs in the laboratory (Materu, 1971 : 380). None of these appears likely to cause a significant degree of mortality in the field. Materu (1970; 1971) describes the damage caused by this species and gives an account of its biology in Tanzania. The same author (Materu, 1972) describes and figures egg, nymph and adult. Accounts of control measures are given by Burnett, Lee & Park (1966), Materu & Makusi (1972; 1973) and Swaine (1969). Bohlen (1973 : 33, fig. 157) gives a coloured figure of the adult.

DISTRIBUTION. Much of central, eastern and southern Africa (but not the extreme south), Madagascar, Seychelles, Réunion, Mauritius, Rodriguez, São Tomé, Príncipe, Canary Islands, Cape Verde Islands, Yemen; recorded by Chiaromonte (1934) from Somalia; absent from the mainland of West Africa.

MATERIAL EXAMINED

Clavigralla elongata Signoret, lectotype ♂, **Tanzania**: Zanzibar (NM, Vienna). *Clavigralla flavipennis* Signoret, lectotype ♀, **Madagascar** (NM, Vienna).

Numerous specimens from the following localities. **Canary Islands.** **Cape Verde Islands:** Sao Nicolau, Ribiera do Recanto. **Yemen:** Hodeida, Wadi Bohl. **Ethiopia:** Mt Chilalo. **Sao Tomé:** Vallée Ribiera Palma. **Principe.** **Zaire:** Kongo Central, Banana; Kongo Central, Mpese; Bandundu, Popokabaka; Bandundu, Ngowa (near Popokabaka); Kasai Orientale, Sankuru, Gandajika; Orientale, Faradje; Kivu, Lwiro; Kivu, Uvira; Kivu, Butembo; Kivu, Terr. Beni, M. Bau; Kivu, Plaine de la Ruzizi; Kivu, Kasongo; Lulaba River; Katanga, Kambove; Katanga, Lubumbashi; Katanga, Moliro. **Rwanda:** Rubona. **Burundi:** Bururi. **Uganda:** Mabira Forest; Jinja; Entebbe; Kampala; Koki Country, SW. Buddu; Mt Kokanjero, SW. of Elgon; Valley of Kafu River, Unyoro; Mpanga Forest, Toro; Maramas District, Ilala, 22 km E. of Mumias; near Masindi; S. Lake Albert; Yingo; Namanve; Bugoma; Masindi. **Kenya:** Mombasa, 19 km NW. of Mazera; Mombasa, 16 km inland, Changamwe; Mombasa; Kwale; Langata; Teita Hills; Teita Hills, Wundanyi; Rabai; Kaimosi; Lake Jipe; Nyeri; Tumutumu; Bwamba Valley; Naivasha; Diani Beach; Nairobi. **Tanzania:** Zanzibar; Mt Chala; Biharamulo; Ukiriguru; E. Rukwa; Rukwa Rift; Kafukola; Dar-es-Salaam; Bukoba. **Angola:** 19 km SW. of Luimbale; 6 km SW. of Quirimbo. **Zambia:** Lake Bangweolo, Chishi Island; Upper Luangwa River; between Ft Jamieson and Lundazi; Lake Bangweulu, Mbawala. **Malawi:** Nkata Bay; Zomba; between Ft Maguire and Ft Johnston, SE. shore of Lake Nyasa; Mlanje Plateau; Mlanje. **Mozambique:** Ruvo Valley; valley of Kola River, near E. Mt Chiperrone; Serra da Gorongosa; Lower Zambesi River, Luambo. **Rhodesia:** Umtali; Mashonaland. **South Africa:** Transvaal, Elandshoek; Tvl, Louis Trichard; Tvl, Karino; Natal, Malvern; Natal, Pine-town; Natal, Durban; Natal, Verulam; Natal, Tugela River, near Weenen; Natal, Umbilo; Natal, Isipingo; Natal, Kloof; Natal, Port Shepstone; Natal, Umkomaas River; Natal, Port Natal; Natal, Pondoland, Port St Johns; Natal, 32 km S. of Durban, Illova River Mouth; Natal, Umtentweni; Natal, Eshowe, Natal, Umkomaas; Natal, Umhlali; locality uncertain, 'C. Bon. Spei'. **Seychelles:** Praslin; Mahé, Silhouette. **Madagascar:** Lac Alaotra; Centre Ferme de Nanisana; Baie d'Antongil; Fénériver, Soaniérana; Diego-Suarez; Rég. Sud, Bekily; Amparafaravola (E. of Lake Alaotra); Rég. Sud, Andrahomana; Antanambé; South-east, Plaines d'Ambolisatra. **Réunion:** Bretagne. **Mauritius:** Vacoas. **Rodriguez.**

Altitudes, recorded on labels: 150–2000 m, mostly in the range 1000–1700 m, one locality at 2600 m in Ethiopia.

Host-plants recorded on labels: 'Canadian Wonder' beans (*Vicia faba* Linnaeus), cowpea (*Vigna* sp.) and '*C. procera*' in Tanzania, Soja (*Glycine*) in Madagascar and *Cajanus indicus* Sprenger in Réunion.

Other habitat and biological information on labels: in forest (twice); beside lake; among lake shore vegetation; 'cocotiers morts, rid. forêt'; ex crop of guinea fowl (twice).

Depositories of material: IRSNB, Brussels; NM, Bulawayo; Duarte coll.; BMNH, London; AMNH, New York; UM, Oxford; MNHN, Paris; PPRI, Pretoria; TM, Pretoria; CAS, San Francisco; MRAC, Tervuren; Slater coll.

Clavigralla shadabi sp. n.

(Figs 66–71)

Length: ♂, 7.9–9.8 mm, mean 8.9 mm ($n = 18$); ♀, 8.5–10.5 mm, mean 9.7 mm ($n = 27$). Very similar in overall appearance to *C. elongata*.

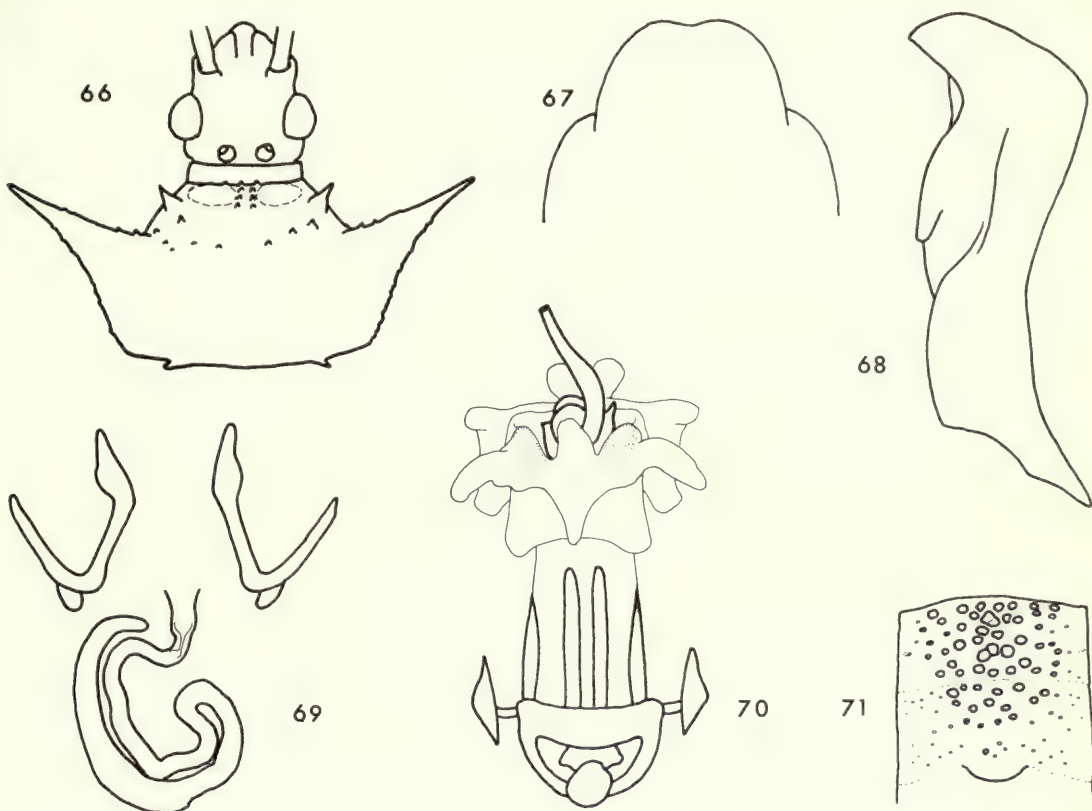
Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.81 : 0.81 : 0.77, in female about 1.00 : 0.81 : 0.80 : 0.74. Length of antennal segment I divided by width of head including eyes in male 1.49–1.67, mean 1.57 ($n = 18$), in female 1.39–1.62, mean 1.50 ($n = 26$). Ratio of lengths of rostral segments I : II : III : IV in male about 1.00 : 0.92 : 0.62 : 0.96, in female about 1.00 : 0.90 : 0.60 : 0.94.

Pronotum (Fig. 66) with posterolateral angles in general more strongly produced, slightly more anteriorly directed and narrower than in *C. elongata*; disc with a semicircle of spines distributed as in *elongata* but the anterior pair much more prominent than the rest; width across apices of posterolateral spines divided by width of head including eyes in male 2.73–3.52, mean 3.03 ($n = 18$), in female 2.67–3.59, mean 3.03 ($n = 25$). Posterior tibia almost straight, its length divided by length of posterior femur 0.71–0.92, mean 0.81 ($n = 43$).

Male genital capsule with lip (Fig. 67) broad, paramere (Fig. 68) with prominent ridge on dorsomedial face. Conjunctiva (Fig. 70) differs from that of *elongata* and its close allies in that well-developed, membranous distal dorsolateral lobes are present and apex of distal dorsomedian lobe is narrow and directed anteriorly. Vesica rather short, sclerites protecting its base both with outer apical angle at least right-angled and usually, in either or both, acutely projecting laterad. Sclerites of dorsal wall of gynatrium

(Fig. 69) slender, with a subterminal expansion on median arm of each. Duct of spermatheca (Fig. 69) with convoluted portion short, broad, thin-walled section communicating with gynatrium very short.

Abdominal terga III and IV with a patch of punctures common to both, size of punctures greatest in middle of segment III, decreasing fairly uniformly in all directions away from this area (Fig. 71). Scutellum frequently with pale, silvery white hairs organized into a distinct, narrow, longitudinal median line; pronotum with obscure traces of three longitudinal lines of similar pubescence. Sculpture, pubescence and coloration otherwise very similar to those of *C. elongata*.



Figs 66–71 *Clavigralla shadabi*. (66) head and pronotum, dorsal view; (67) lip of ♂ genital capsule, posteroventral view; (68) paramere, dorsal view; (69) spermatheca and sclerites of dorsal wall of gynatrium, dorsal view; (70) aedeagus, dorsal view; (71) abdominal tergites III and IV.

REMARKS. This is the insect known to West African entomologists as *Acanthomia horrida*. Under this name it was recorded as a pest of cowpea (*Vigna*) by Booker (1965), Taylor & Omoniyi (1972) and Aina (1972). The last-named author recorded an unnamed ectoparasitic mite and *Rhinocoris bicolor* (Fabricius), a predaceous reduviid bug, as natural enemies. The range of this species overlaps with that of *C. elongata* in a large area of Zaire. The two species may be readily distinguished by comparison of the sizes of the spines on the disc of the pronotum. The length and thickness of the prominent posterolateral angles of the pronotum vary markedly between series from different localities. For example, these spine-like processes are much longer and thinner in specimens from Nero Mer, Ivory Coast and Bambesa, Zaire than they are in specimens from Lamto, Ivory Coast and Faradje, Zaire. There is marked variation between individuals in the shape of the apices of the sclerites protecting the base of the vesica and also in the length of the posterior tibia. None of these variations appears to be linked with any other, nor do they vary systematically with large-scale geographical range.

DISTRIBUTION. West and Central Africa, extending north-eastwards to S. Sudan. Not recorded to the east of the Great Rift Valley or south of latitude 12° S.

MATERIAL EXAMINED

Holotype ♂, **Nigeria**: Samaru, ix.1961, on cowpea (*Vigna catjang* Endlicher) (Dept of Agric, N. Nigeria) (BMNH, London).

Paratypes. **Sudan**: 1 ♀, Blue Nile, Abu Hashim to Galegu, 23–24.xi.1962 (*R. Linnavuori*) (BMNH, London). **Sierra Leone** [?]: 1 ♀, 'Sierra. Haw. W.' (UM, Oxford). **Ivory Coast**: 2 ♂, 8 ♀, Toumodi, Lamto, 30.iii, 3.vii, 4.xii.1962, 2.i, 4.vi, 11.vi.1963, 21.vii.1964 (*D. Gillon*); 4 ♂, 4 ♀, Nero-mer, 30.x.1963 (*Gillon*) (BMNH, London). **Ghana**: 1 ♂, Tafo, 27.xi.1962 on *Asclepias* (*B. Gerard*) (BMNH, London). **Togo**: 1 ♂, 2 ♀, Yoh, 12.vi.1963 (*Mme Y. Schach*) (MRAC, Tervuren). **Nigeria**: 1 ♂, 4 ♀, Bida, weeds on fallow land, 22–23.ix.1955 (*M. G. Emsley*); 1 ♂, no exact locality, on leaf of *Phaseolus aureus*, 22.viii.1953 (*Emsley*); 1 ♀, Ibadan, on cowpea (*Vigna*), 17.vi.1962 (*T. A. Taylor*); 1 ♂, Shendam, at light, 26.ix.1955 (*Emsley*); 1 ♂, 1 ♀, Akpashe District, Udi, 28.x.1955 (*Bechyne*) (BMNH, London). **Cameroun**: 1 ♀, Batouri District, savannah country, 1.i–24.ii.1936 (*F. G. Merfield*) (BMNH, London). **Zaire**: 72 ♂, 90 ♀, Orientale, Faradje, 29° 40' E, 3° 40' N, i.1913 (*Lang & Chapin*) (AMNH, New York); 5 ♂, 6 ♀, Orientale, Bambesa, 1937–1938 (*J. Vrydagh*); 1 ♂, Kivu, Kasongo, ix.1959 (*P. L. G. Benoit*); 1 ♀, Katanga, Kiambi, Manono, Riv. Luvua, x.1956 (*N. Leleup*) (MRAC, Tervuren); 1 ♂, Katanga, Nyunzu, 1955 (*L. Henry*); 1 ♂, 2 ♀, Kivu, Kibangula, ii.1955, 1956 (*Henry*); 2 ♂, 2 ♀, Katanga, Lubumbashi, i.1939, 9.iii.1939 (*H. Brédo*); 1 ♀, Kongo Central, Mpese, v–vi.1937 (*R. P. J. Cooreman*); 16 ♂, 10 ♀, Orientale, Bambesa, 11–12.vi, 13.xi.1937, 18–21.xii.1939, 6–8.i.1940 (*J. Vrydagh*); 7 ♂, 17 ♀, Bandundu, Ngowa (near Popokabaka), 16–17.ii.1938, 16.xi.1938, 17.vi.1939, 2.vii.1939 (*R. P. J. Mertens*) (IRSNB, Brussels).

Material excluded from type-series. **Ghana**: 1 ♀, Mt Atewa, 15.xii.1967 (*D. Leston*); 1 ♀, Oyoko, 24.xi.1966 (*Leston*); 2 ♀, Legon, 2.x.1968 (*R. Kumar*); 1 ♀, Tafo, 20.iv.1966, by pyrethrum knockdown from cocoa; 1 ♂, 3 ♀, Tafo, 13.v.1966, 14.v.1966, 3.i.1967 (*Kumar*) (UG, Legon). **Nigeria**: 3 ♂, 6 ♀, Zaria, Samaru, all on cowpea (*Vigna*), ix.1961, 31.viii.1966, 14.ix.1966 (*J. C. Deeming*) (IAR, Samaru). (Received after description was prepared.)

Clavigralla breviceps sp. n.

(Figs 72–76)

Length: ♂, 7.5–8.3 mm, mean 7.8 mm ($n = 4$); ♀, 7.8–8.3 mm, mean 8.1 mm ($n = 5$). Closely resembles *C. elongata* in body form but smaller.

Head short, broad, eyes prominent (Fig. 72). Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.83 : 0.82 : 0.77, in female about 1.00 : 0.81 : 0.81 : 0.77. Length of antennal segment I divided by width of head including eyes in male 1.16–1.24, mean 1.21 ($n = 4$), in female 1.11–1.20, mean 1.15 ($n = 5$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.88 : 0.49 : 0.82.

Pronotum (Fig. 72) with a pair of stout, blunt spines near anterolateral margins of disc with a few, blunt spines behind them. Width of pronotum across apices of posterolateral spines divided by width of head including eyes in male 2.67–2.91, mean 2.80 ($n = 4$), in female 2.74–2.95, mean 2.82 ($n = 4$). Length of posterior tibia divided by length of posterior femur 0.71–0.80, mean 0.75 ($n = 9$).

Male genital capsule with lip (Fig. 75) broad, paramere (Fig. 73) broader at apex in proportion to length compared to that of *C. elongata*. Conjunctiva as in *elongata*. Sclerites of dorsal wall of gynatrium (Fig. 74) slender, duct of spermatheca (Fig. 74) very short.

Abdominal tergites III and IV (Fig. 76) with numerous, large and medium sized punctures over most of their width. Tibiae with brown annuli at base, apex and middle, tarsi brown except for most of dorsal surface of first segment. Sculpture, pubescence and coloration otherwise similar to that of *elongata*.

REMARKS. The smallest of the species closely allied to *C. elongata* and readily distinguished from its relatives by the short head and the colour of the tibiae and tarsi.

DISTRIBUTION. West Africa and Zaire, not common.

MATERIAL EXAMINED

Holotype ♂, **Nigeria**: near Zaria, Samaru, at grass roots, 12.ix.1954 (*M. G. Emsley*) (BMNH, London).

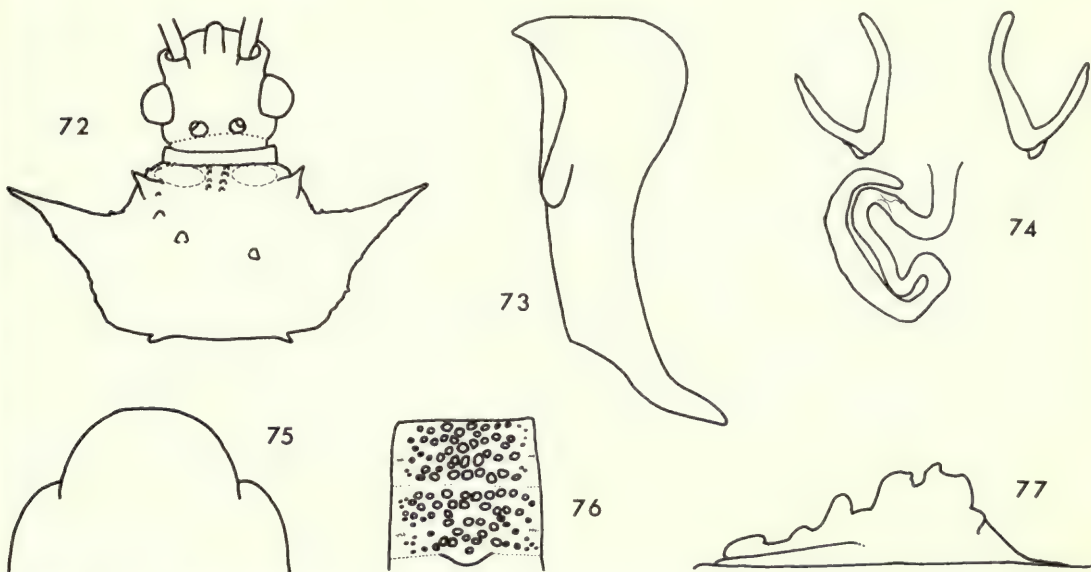
Paratypes. **Nigeria**: 1 ♂, Samaru, in mercury vapour light-trap, 1–8.viii.1970 (*P. H. Ward*); 1 ♀, swept from grasses and flowers, 30–31.vii.1970 (*Ward*) (BMNH, London). **Zaire**: 2 ♂, 4 ♀, 1 ex. without abdomen, Orientale, Faradje, 3° 40' N, 29° 40' E, i.1913 (*Lang & Chapin*) (AMNH, New York and BMNH, London).

Clavigralla ankatsoensis sp. n.

(Fig. 77)

Length: ♀, 9.9 mm (n = 2). ♂ unknown. Very similar to *C. elongata* in almost all respects.

Ratio of lengths of antennal segments I : II : III : IV in holotype 1.00 : 0.85 : 0.81 : 0.91; length of segment I divided by width of head including eyes in holotype 1.31. Antennae completely lacking in paratype. Ratio of lengths of rostral segments I : II : III : IV about 1.00 : 0.90 : 0.55 : 0.91. Width of pronotum across apices of posterolateral spines divided by width of head including eyes in paratype 2.81. Apices of both posterolateral spines lacking in holotype. Scutellum (Fig. 77) much less strongly convex than in *C. elongata* and with more prominent tubercles. Posterolateral angles of abdominal sternites III–VII produced into spines which stand almost perpendicular to lateral margin of abdomen (as in *C. madagascariensis* and *C. asterix*, Figs 79, 80). Length of posterior tibia divided by that of posterior femur about 0.78. Pubescence of scutellum distinctly less dense than in *C. elongata*.



Figs 72–77 *Clavigralla* species. (72) *breviceps*, ♂ head and pronotum, dorsal view; (73) same, paramere, dorsal view; (74) same, spermatheca and sclerites of dorsal wall of gynatrium, dorsal view; (75) same, lip of ♂ genital capsule, posteroventral view; (76) same, ♀ abdominal tergites III and IV; (77) *ankatsoensis*, scutellum, left lateral view.

REMARKS. Distinguished from *C. madagascariensis* and *C. asterix* by the presence on the scutellum of sparse, erect pubescence and larger tubercles, but resembles them in the form of the posterolateral spines of the abdominal sternites.

DISTRIBUTION. Known only from the type-locality in Madagascar.

MATERIAL EXAMINED

Holotype ♀, **Madagascar**: Ankatso, ii.1921 (*R. Decary*) (MNHN, Paris).

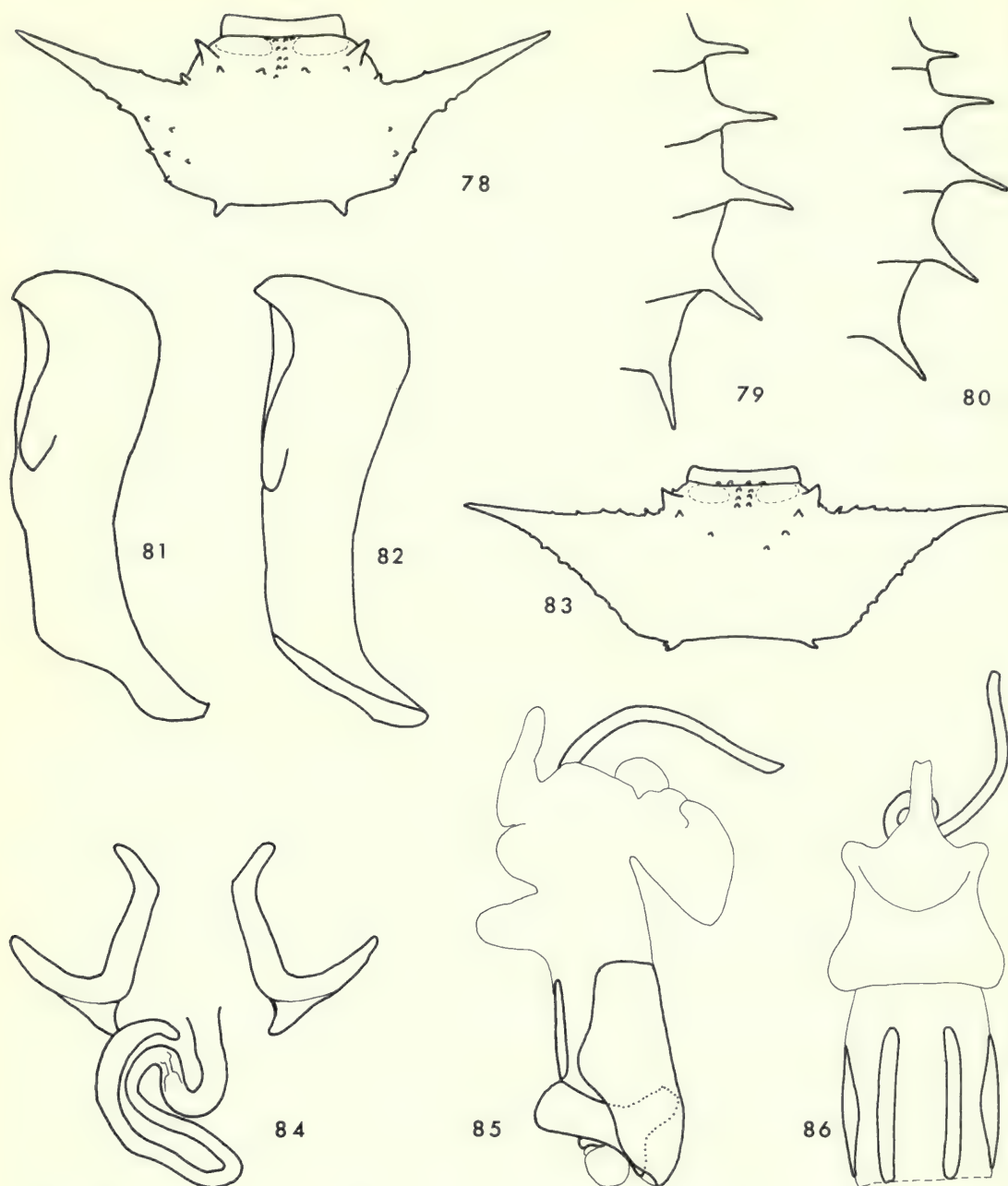
Paratype. **Madagascar**: 1 ♀, same data as holotype (MNHN, Paris).

Clavigralla madagascariensis sp. n.

(Figs 78, 79, 81, 84)

Length: ♂, 8.0–9.0 mm, mean 8.5 mm (n = 5); ♀, 8.7–9.6 mm, mean 9.2 mm (n = 4). Similar to *C. elongata* in overall appearance but differs in the longer spines at sides of thorax and abdomen, which are more nearly perpendicular to body margin.

Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.81 : 0.74 : 0.77, in female about 1.00 : 0.83 : 0.75 : 0.78. Length of antennal segment I divided by width of head including eyes in



Figs 78–86 *Clavigralla* species. (78) *madagascariensis*, ♀ pronotum, dorsal view; (79) same, lateral margins of ♀ abdominal sternites III–VII, ventral view; (80) *asterix*, holotype ♂, lateral margins of abdominal sternites III–VII; (81) *madagascariensis*, paramere, dorsal view; (82) *asterix*, paramere, dorsal view; (83) same, holotype ♂, pronotum, dorsal view; (84) *madagascariensis*, spermatheca and sclerites of dorsal wall of gynatrium, dorsal view; (85) *asterix*, aedeagus, left lateral view; (86) same, dorsal view, basal apparatus omitted.

male 1.56–1.66, mean 1.61 ($n = 5$), in female 1.42–1.64, mean 1.54 ($n = 4$). Ratio of lengths of rostral segments I : II : III : IV about 1.00 : 0.88 : 0.46 : 0.77.

Pronotum (Fig. 78) with posterolateral angles drawn out into long, slender, anterolaterally directed spines; width across apices of spines divided by width of head including eyes in male 3.36–3.90, mean 3.58 ($n = 4$), in female 3.00–3.67, mean 3.40 ($n = 4$). Scutellum convex, but less so than in *C. elongata*, depressed in midline. Corium with apex at rest reaching level of middle of laterotergite VI. Posterior tibia almost straight, its length divided by length of posterior femur about 0.83.

Abdominal sterna III–VII with posterolateral angles drawn out into long spines (Fig. 79), the spines almost perpendicular to abdominal margin and rather slender. Paramere (Fig. 81) and conjunctiva very similar to those of *C. elongata*. Ovipositor as in *elongata*; sclerites of wall of gynatrium (Fig. 84) slender, sharply angled outwards apically; spermatheca (Fig. 84) with bulb narrow, duct short and not convoluted.

Sculpture, pubescence and colour generally as in *C. elongata* except that pubescence of pronotum and scutellum is much shorter, scutellum completely lacking erect or suberect pubescence and only a few hairs of this type present on pronotum.

REMARKS. Differs from *elongata* in the average longer pronotal posterolateral spines, in the arrangement of spines on pronotal disc, which resembles that of *shadabi*, in the form of the sclerites of the gynatrial wall and the form of the spermatheca and in the spines at the posterolateral angles of the abdominal sternites, which are almost perpendicular in this species and deflected posteriorly in *elongata*. Clearly forms a group with *ankatsoensis* and *asterix* but differs from the former in the absence of erect pubescence on the scutellum and from the latter in the form of the pronotum. In a long series of *elongata* from Baie d'Antongil in the MNHN, Paris are three females which appear to be intermediate between *madagascariensis* and *elongata*. In all three the pronotal posterolateral angles are very strongly produced and in two of them the spines at the posterolateral angles of the abdominal sternites stand out almost perpendicular to the sides of the body. In all three the scutellum is as strongly convex as in *elongata* but has only a few outstanding hairs in addition to the dense, decumbent pubescence. One female was dissected and proved to have the spermathecal duct and the sclerites of the wall of the gynatrium intermediate in form between the two species. This mixture of characters suggests that there may be some genetic interchange between the two species.

DISTRIBUTION. Madagascar.

MATERIAL EXAMINED

Holotype ♂, **Madagascar:** Antalaha, xii.1935 (*Vadon*) (MNHN, Paris).

Paratypes. **Madagascar:** 1 ♂, 1 ♀, Tananarive, 1898 (*Noualhier*) (MNHN, Paris); 4 ♂, 2 ♀, Fampanambo, iii.1959, x.1959, 1962 (*J. Vadon*) (MRAC, Tervuren and BMNH, London).

Clavigralla asterix sp. n.

(Figs 80, 82, 83, 85, 86)

Length: ♂, 8.0–8.2 mm ($n = 2$); ♀, 8.7 mm ($n = 1$). Closely related to *C. elongata*, *ankatsoensis* and *madagascariensis*, which it resembles in most features.

Ratio of lengths of antennal segments I : II : III : IV in males 1.00 : 0.80 : – and 1.00 : 0.86 : – : –, in female 1.00 : 0.82 : 0.78 : – (– denotes missing segment). Length of segment I divided by width of head including eyes in males 1.26 and 1.35, in female 1.36. Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 1.00 : 0.56 : 0.93.

Pronotum (Fig. 83) with posterolateral angles produced into long, very broadly based, laterally directed spines; width across apices of spines divided by width of head including eyes 3.79 in holotype male, apices of spines missing in paratypes. Arrangement of semicircle of spines on disc of pronotum as in *shadabi* and *madagascariensis*. Scutellum less strongly convex than that of *C. elongata*. Corium with apex at rest reaching to level of basal half of laterotergite VI. Posterior tibia very weakly curved at base, its length divided by that of posterior femur about 0.79.

Abdominal sternites III–VII with posterolateral angles produced into long, broadly based spines perpendicular to abdominal margin (Fig. 80). Paramere (Fig. 82) and conjunctiva (Figs 85, 86) differing little from those of *C. elongata*. Sclerites of wall of gynatrium slender, long, resembling those of *madagascariensis*. Spermatheca with bulb longer and more slender than that of *madagascariensis*, with a slender, distal tail, duct not convoluted and about one and one-third times as long as bulb. Sculpture, colour and

pubescence as in *elongata*, except that pubescence of scutellum and pronotum resembles that of *madagascariensis* in that scutellum lacks outstanding hairs and pronotum has only a few, short, erect hairs arising from granules at margins.

REMARKS. Resembles *madagascariensis* in most of the features in which it differs from *elongata*; readily distinguished from all its relatives by the form of the posterolateral pronotal angles.

DISTRIBUTION. Known only from the type-locality in Madagascar.

MATERIAL EXAMINED

Holotype ♂, **Madagascar**: Ambohimombo, 1894 (*Forsyth-Major*) (BMNH, London).

Paratypes. **Madagascar**: 1 ♂, 1 ♀, Ambohimombo Forest, 24.i.1895 (*Forsyth-Major*) (BMNH, London).

Clavigralla schnelli (Villiers) **comb. n.**

(Figs 87–96)

Myla schnelli Villiers, 1950 : 656–658, fig. 16. Holotype ♂, GUINEA (MNHN, Paris) [not examined].

[*Myla gracilis* Schouteden; Linnavuori, 1971 : 175. Misidentification.]

Lancha schnelli (Villiers); Shadab, 1972 : 1–11.

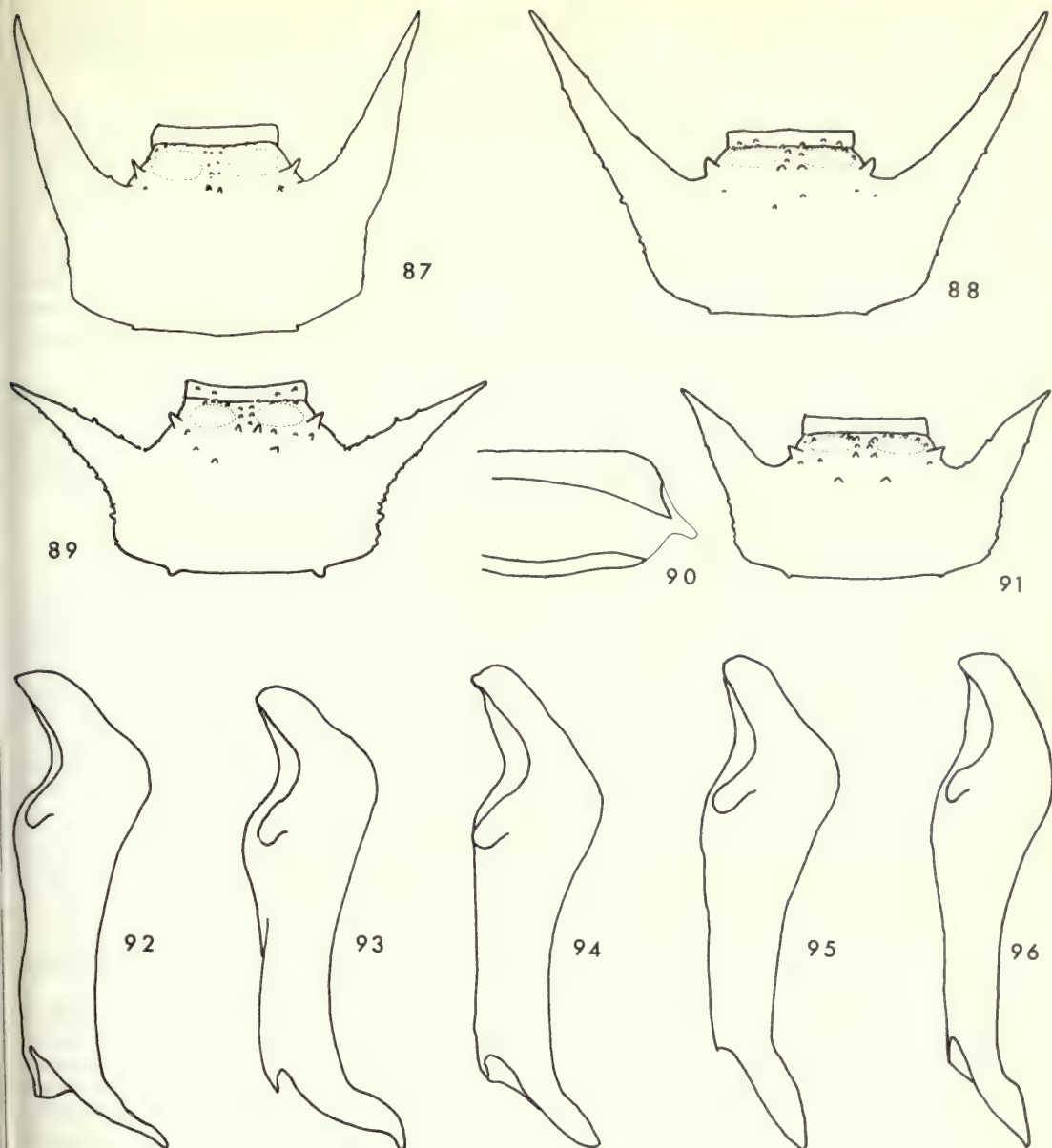
Length: ♂, 8.8–11.2 mm, mean 10.1 mm ($n = 24$); ♀, 9.3–12.0 mm, mean 11.1 mm ($n = 21$). Resembles *C. elongata* in general appearance.

Antennifers slightly divergent. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.75 : 0.77 : 0.76, in female about 1.00 : 0.74 : 0.75 : 0.71. Length of segment I divided by width of head including eyes in male 1.68–2.14, mean 1.96 ($n = 22$), in female 1.79–2.12, mean 1.98 ($n = 20$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.87 : 0.67 : 0.99.

Pronotum (Figs 87–89, 91) moderately declivent anteriorly, prescutellar spines small, disc with a few, small, spine-like tubercles and a pair of larger spines close to mid-point of anterolateral margins, posterolateral angles drawn out into long, tapering spines which are very variable in shape and are directed more or less obliquely forward. Length of posterolateral spine, measured from extreme posterolateral angle of pronotum to apex of spine, divided by width of head including eyes in male 1.29–2.09, mean 1.82 ($n = 21$), in female 1.78–2.23, mean 1.97 ($n = 19$); distance between apices of spines divided by width of head including eyes in male 2.71–3.94, mean 3.23 ($n = 21$) in female 2.77–3.83, mean 3.20 ($n = 19$); length of spines not closely correlated with distance between their apices due to extreme variability of angle at which they project from pronotum. In most examples seen apices of posterolateral spines fall anterior to level of anterior margin of pronotum, but in some examples with short, widely spreading spines the apices do not project anteriorly beyond anterior margin of calli. Scutellum slightly longer than wide, flat or with disc very slightly convex, coarsely granulate-punctate; its most prominent feature the two basal, raised knobs. Corium with apex narrowly produced, its apex at rest reaching posteriorly to level of basal one-quarter of laterotergite VI. Metathoracic wing with antevannal vein well defined (not shown by Shadab, 1972 : fig. 8). Anterior and intermediate femora without subapical spines, posterior femur with two long, subapical spines beneath, about 6 very small spines between them and an apical series of 3–4 spines; posterior tibia straight, its length divided by length of posterior femur 0.76–0.88, mean 0.82 ($n = 39$).

Abdominal sternites III–VII with posterolateral angles produced into very slender, posteriorly directed spines (Shadab, 1972 : fig. 1; Villiers, 1950 : fig. 16). Male genital capsule with posterior lip entire, moderately broad, tongue narrowly pointed. Paramere (Figs 92–96) with apical margin strongly oblique, apex rarely more prolonged (Fig. 94), external angle of blade rarely more broadly rounded (Fig. 96) than usual. Conjunctiva entirely membranous, ventrally with distal ventrolateral and apical ventral lobes normally developed, dorsally with distal dorsolateral lobes absent, distal dorsomedian lobe obsolete, intermediate dorsal lobe very large, high, conical, slightly bifid laterally at apex, dorsomedian lobe transverse, each of its dorsal angles with a vertical, finger-like lobe about as high as main part of dorsomedian lobe. Female with abdominal sternite VII cleft for one-third of its length. Second valvula with a single, entire process at apex (Fig. 90). Spermatheca (Shadab, 1972 : fig. 18) with bulb very narrow, duct slightly undulating but not convoluted. Sclerites of wall of gynatrium V-shaped; median, longitudinal arms gently convergent apically, about one and one-third times as long as anterior, transverse arms.

Head obsoletely granulate-punctate. Pronotum fairly strongly, thoracic pleura and scutellum less strongly granulate-punctate. Basal halves of anterior veins of corium granulate, clavus and corium punctate. Antennal segments I–III and femora minutely and sparsely granulate. Thoracic and abdominal sterna rastrate.



Figs 87-96 *Clavigralla schnelli*. (87) pronotum of ♀, Zaire, Faradje; (88) pronotum of ♂, Ivory Coast, Lamto; (89) pronotum of ♂, Zaire, Mpese; (90) apex of second valvula of ovipositor, left lateral view; (91) pronotum of ♂, Zaire, Macaco, Luebo, dorsal view; (92) left paramere, dorsal view, Ivory Coast; (93) same, Zaire, Macaco, Luebo; (94) same, Luebo; (95) same, Zaire, Mpese; (96) same, Zaire, Ngowa.

Head, pronotum, scutellum, clavus, corium, thoracic pleura, abdominal sterna, legs and antennae with short, semierect pubescence. Decumbent, white pubescence present on head, all exposed parts of thorax and abdomen and on clavus, corium and femora, this pubescence forming dense, white, narrow bands along midline of pronotum and scutellum and along anterolateral margins of pronotum, four narrow, longitudinal bands on vertex and a broad, transverse band on disc of pronotum.

General coloration of exposed parts of head, thorax and abdomen and of clavus and corium pale ferruginous-brown, becoming darker and redder towards apices of posterolateral pronotal angles; spines

at apices of pronotal posterolateral angles and spines at abdominal margin piceous. Abdomen sometimes with 2–5 paler, continuous, longitudinal bands beneath. Rostrum concolorous with body, antennae and legs stramineous, sometimes with apical part of posterior femur ferruginous-brown.

REMARKS. A distinctive species, figured in dorsal view by Villiers (1950 : fig. 16) and Shadab (1972 : fig. 1). The form of the pronotum and to a lesser extent of the parameres are variable and are often characteristic for a particular locality though they do not vary systematically on a large geographical scale. The extreme forms of the paramere shown in Figs 94 and 96 are from individuals which appear to have suffered some damage during growth. There is no evidence from the genitalia to justify the division of this taxon into more than one species despite the great variability of the pronotum. Specimens with less well-developed pronotal posterolateral angles might be confused with *C. shadabi* but may be distinguished from that species by the narrower body and from it and all species of the *elongata*-group by the flat or just perceptibly convex scutellum.

There is a specimen of this species in MRAC, Tervuren labelled as 'Holotype' of *Myla gracilis* Schouteden. It was not designated by Schouteden (1938 : 293) in his original description of *M. gracilis* and, although it is evidently part of his (mixed) type-series, it disagrees with the detailed description of *gracilis* in respect of the antennifers, rostrum, antennae, femora and genital capsule.

DISTRIBUTION. West and Central Africa.

MATERIAL EXAMINED

Guinea: 1 ♂, Mt Nimba, Kéoulenta, 11.vi.1942 (*M. Lamotte*) (MNHN, Paris) (paratype of *Myla schnelli* Villiers). **Ivory Coast:** 10 ♂, 10 ♀, Toumodi, Lamto, 11.ix, 6.xi, 4.xii.1962, 2.i, 26.ii, 13.iii, 23.iv, 7.v, 14.v.1963, 13.vii, 24.vii.1964 (BMNH, London). **Zaire:** 6 ♂, 10 ♀, Faradje, 3° 40' N, 29° 40' E, i.1913 (*Lang & Chapin*); 1 ♂, Faradje, i.1912 (*Lang & Chapin*); 1 ♂, 1 ♀, Medje, 2° 25' N, 27° 15' E, 10.iv.1910 (*Lang & Chapin*) (AMNH, New York); 2 ♂, Mpese, v–vi.1937 (*R. P. J. Cooreman*); 1 ♂, Ngowa, 16.xi.1938 (*R. P. J. Mertens*); 1 ♀, Ngowa, 1938 (*J. Mertens*) (IRSNB, Brussels); 1 ♂, Luebo, on *Urena lobata* Linnaeus (Malvaceae) viii.1921 (*Lt Ghesquière*) (labelled 'holotype'); 1 ♂, Macaco (Luebo), 30.ix.1921 (*Dr H. Schouteden*) (labelled 'paratype'); 1 ♀, Kikwit, xi.1920 (*P. Vanderijst*) (MRAC, Tervuren) (the last three specimens are syntypes of *Myla gracilis* Schouteden); 1 ♂, 110 km S. of Sampwe, 980 m, 21.i.1958 (*E. S. Ross, R. E. Leech*) (CAS, San Francisco).

Clavigralla mira sp. n.

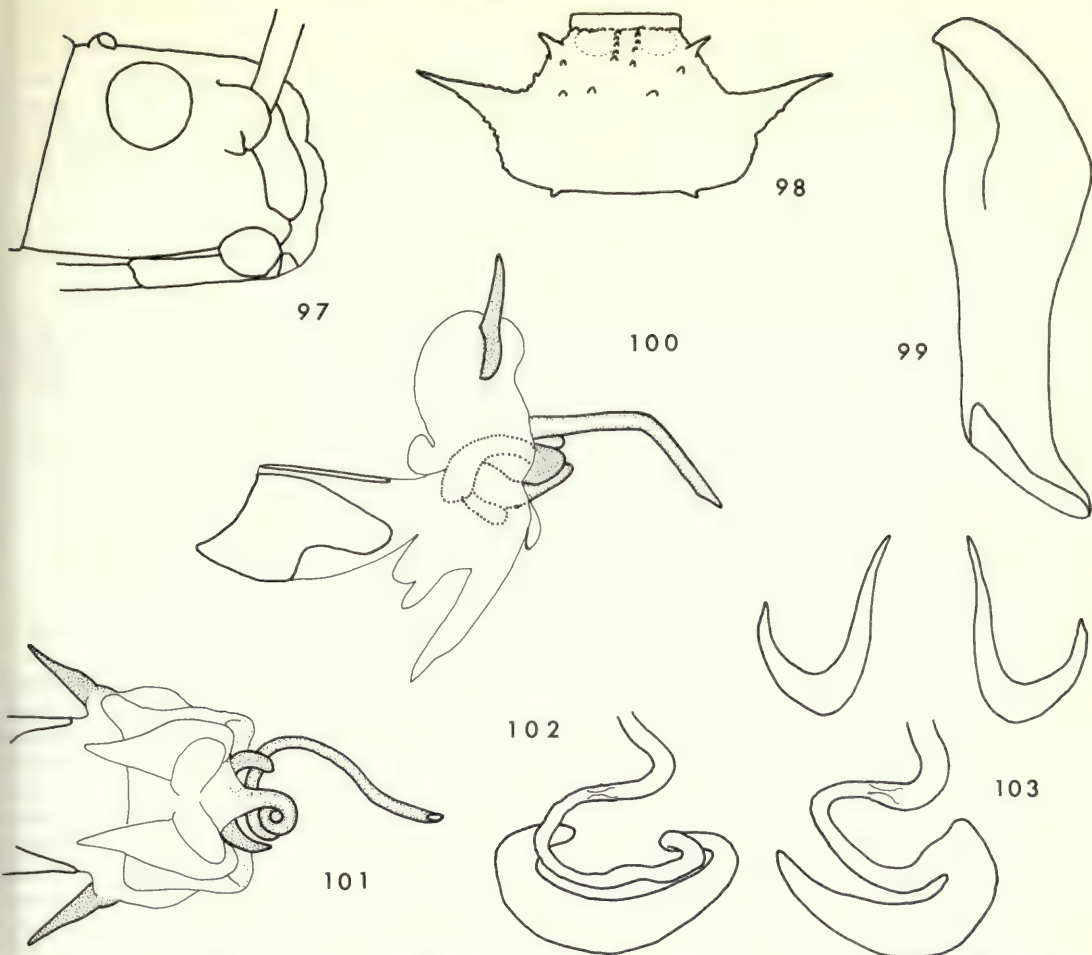
(Figs 97–103)

Length: ♂, 7.5–8.7 mm, mean 7.1 mm ($n = 12$); ♀, 8.0–8.8 mm, mean 8.3 mm ($n = 11$). Rather similar in build and appearance to *C. elongata*.

Antennifers slightly to moderately divergent. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.89 : 0.89 : 0.81, in female about 1.00 : 0.87 : 0.87 : 0.74. Length of antennal segment I divided by width of head including eyes in male 1.26–1.56, mean 1.38 ($n = 13$), in female 1.23–1.38, mean 1.32 ($n = 11$). Rostrum short, at rest with apex of segment I reaching posteriorly to level of centre of eye and apex of segment IV reaching posterior margin of mesosternum. Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.89 : 0.68 : 0.89. Frons strongly elevated between antennifers (Fig. 97), not evenly declivent.

Pronotum (Fig. 98) more shallowly declivent than in *C. elongata*, collar broad, posterolateral angles more nearly perpendicular to sides of body and more slenderly produced; disc of pronotum with a pair of slender spines near middle of anterolateral margins and several much shorter spines behind them; width across apices of posterolateral spines divided by width of head including eyes in male 2.29–2.73, mean 2.54 ($n = 10$), in female 2.27–2.69, mean 2.48 ($n = 11$). Scutellum convex, but less so than in *C. elongata*. Corium with apical margin almost straight, apex scarcely produced and reaching only to base or middle of laterotergite VI. Anterior and intermediate femora each with or without a small, subapical spine beneath, posterior femur with two major subapical spines, 0–2 very small spines between them and an apical series of 3–4 spines. Posterior tibia straight, its length divided by that of posterior femur in both sexes 0.78–0.86, mean 0.82 ($n = 19$).

Abdominal sternites III–VII with posterolateral angles more strongly produced than in *C. elongata*, directed posterodorsally. Male genital capsule with lip broad, tongue entire. Paramere (Fig. 99) with apical margin oblique. Conjunctiva (Figs 100, 101) with dorsomedian lobe low, confluent with distal dorso-



Figs 97-103 *Clavigralla mira*. (97) head, ♂, right lateral view; (98) pronotum, ♂, dorsal view; (99) paramere, dorsal view; (100) phallosome, conjunctiva and vesica, left lateral view; (101) conjunctiva and vesica, ventral view; (102) spermatheca, Zaire, Kapanga; (103) spermatheca and sclerites of wall of gynatrium, dorsal view, Ivory Coast.

median lobe and only visible as a small lobe at each side of it; distal dorsomedian lobe voluminous, with a pair of slender, gently curved, sclerotized processes apically; distal dorsolateral lobes absent; apical ventral lobes present, membranous; distal ventrolateral lobes divided, one part of each forming a long, narrow lobe, the other part fused with its fellow on the opposite side to form a low ridge across ventral surface of conjunctiva; left end of this ridge produced into a short, membranous extension. Female with apex of second valvula bearing a more or less acutely pointed, bifurcate process similar to that of *C. elongata*. Spermatheca (Fig. 103) with duct short, gently curved or longer and slightly convoluted. Sclerites of wall of gynatrium as in Fig. 103; gynatrial sac large.

Colour generally dark brown; tibiae, except basal and apical annuli, and first segment of tarsi stramineous; spines of pronotum and abdominal margin black. Pubescence distributed as in *C. elongata*, with the shorter hairs of body, femora and hemelytra white, making whole insect appear grey; midline of pronotum and scutellum marked by a conspicuous line of adpressed, white hairs; two additional, similar lines of pubescence sometimes present, at least anteriorly, on pronotum parallel to midline; dorsum of head, thoracic pleura and lateral areas of abdominal sterna with faint, oblique lines of adpressed, white hairs. Veins of hemelytral membrane dark brown, uninterrupted.

REMARKS. Although closely related to *C. elongata* and its allies by reason of the bifurcate apical appendage of the second valvula, this species is unique in the genus in having sclerotized append-

ages to the distal dorsomedian lobe of the conjunctiva. The asymmetry of the ventral, membranous lobes of the conjunctiva is also remarkable. The spermathecae of two females from Thysville and Kapanga (Zaire) had longer bulbs and ducts than those of examples from Lamto (Ivory Coast) and Ngowa (Zaire) (compare Figs 102, 103). These specimens are excluded from the type-series and the above description is based only on the typical females. No difference was found between the genitalia of males from Lamto and from Nasisi Hills (Tanzania). Males from Zaire and females from Tanzania were unavailable, but see *C. annectans*, below.

DISTRIBUTION. Tropical Africa from Ivory Coast to Tanzania.

MATERIAL EXAMINED

Holotype ♂, **Ivory Coast:** Lamto (Toumodi), 28.v.1964 (*D. Gillon*) (BMNH, London).

Paratypes. **Ivory Coast:** 12 ♂, 10 ♀, Lamto, 3.vii, 4.xii, 18.xii.1962, 15.i, 26.ii.1963, 21.i, 28.i, 1.iv, 28.v, 13.vii, 16.vii, 21.vii, 28.viii.1964 (*D. Gillon*) (BMNH, London). **Zaire:** 1 ♀, Bandundu, Ngowa, xii.1937 (*R. P. J. Mertens*) (IRSNB, Brussels). **Tanzania:** 1 ♂, Nasisi Hills, 20 miles (32 km) N. of Mumias, 4800 ft (1460 m), 14–15.vi.1911 (*S. A. Neave*) (BMNH, London).

Material excluded from type-series. **Zaire:** 1 ♀, Kongo Central, Thysville, 1959–1963 (*R. Michaux*); 1 ♀, Kasai Orientale, Kapanga, xi.1933 (*G. F. Overlaet*) (MRAC, Tervuren).

***Clavigralla annectans* sp. n.**

(Figs 243–246)

Length: ♂, 8.2 mm ($n = 1$). Known only from the holotype. Indistinguishable in external appearance from *C. mira*, which it resembles in form, sculpture, pubescence and coloration, and especially in the bulging frons (Fig. 243).

Length of antennal segment I divided by width of head including eyes 1.50; ratio of lengths of antennal segments I : II : III : IV as 1.00 : 0.83 : 0.79 : 0.69. Length of rostral segment I divided by width of head including eyes 0.59, ratio of lengths of rostral segments I : II : III : IV as 1.00 : 0.90 : 0.66 : 0.90. Width of pronotum across apices of posterolateral spines divided by width of head including eyes 2.35. Length of posterior femur divided by length of posterior tibia 0.81. Paramere (Fig. 244) with first tooth of blade well developed (obsolete in *mira*). Conjunctiva (Figs 245, 246) with dorsomedian lobe well developed, extending medially in an erect, narrowly conical lobe and laterally in similar sized, posteriorly directed lobes; distal dorsomedian lobe very small and narrow, distal dorsolateral lobes obsolete, intermediate dorsal lobe absent; no sclerotized appendages present on any dorsal lobe; ventral apical lobes of normal size and shape for the genus, their surfaces minutely warty; distal ventrolateral lobes normally developed, lightly sclerotized; no other lobes present; all of conjunctiva symmetrical. Ejaculatory reservoir complex with wings and straps long.

REMARKS. Differs from *C. mira*, to which it is obviously closely related, in the more strongly toothed paramere and particularly in the symmetrical conjunctiva lacking dorsal sclerotized appendages. The form of the conjunctiva is typical of the genus but the inflated frons is a character shared only with *C. mira*. Thus *C. annectans* forms a link between that bizarre species and the normal members of the *elongata*-group. A single specimen of this species was received in a consignment of material sent after the descriptions of the *elongata*-group were prepared. It is possible that the two females excluded from the type-series of *C. mira*, above, on the basis of their longer spermathecal ducts, may prove to belong to the present species if more material with associated males and females should become available. The localities of these two females, Lulua–Kapanga and Thysville, are at 8° 22' S, 22° 37' E and 5° 16' S, 14° 15' E respectively, while the type-locality of *annectans* is at 7° 11' S, 29° 09' E. A female of typical *mira* form is recorded above from Ngowa at 5° 41' S, 16° 41' E. These locality data suggest that *annectans* may be sympatric with *mira* in the middle part of the latter's range, in which case the profound differences in the genitalia between these two superficially indistinguishable species may be the result of strong selection for an isolating mechanism in the recent history of the species pair.

DISTRIBUTION. Zaire.

MATERIAL EXAMINED

Holotype ♂, **Zaire:** 10 miles (16 km) S. of Kapona, 13.i.1958 (*E. S. Ross, R. E. Leech*) (CAS, San Francisco).

Clavigralla insignis (Distant) **comb. n.**

(Figs 104–107, 109)

Acanthomia insignis Distant, 1908 : 442. Holotype ♀, UGANDA (BMNH, London) [examined].

Length: ♂, 8.7–9.2 mm ($n = 2$); ♀, 9.1–9.2 mm ($n = 2$). Similar to *C. elongata* but more brightly coloured and more strikingly patterned and with apical margin of corium almost straight.

Ratio of lengths of antennal segments I : II : III : IV in both sexes about 1.00 : 0.83 : 0.79 : 0.81. Length of segment I divided by width of head including eyes in male 1.39–1.58 ($n = 2$), in female 1.36–1.47 ($n = 2$). Ratio of lengths of rostral segments I : II : III : IV about 1.00 : 0.88 : 0.70 : 0.94 in both sexes.

Pronotum (Fig. 104) with posterolateral spines directed almost perpendicularly to sides of body, width across apices of spines divided by width of head including eyes in male 2.72–2.81 ($n = 2$), in female 2.64–2.67 ($n = 2$). Disc of pronotum with a short, stout spine near middle of each anterolateral margin and a number of smaller, short, blunt spines behind them. Scutellum (Fig. 107) rather strongly convex and a little longer than broad. Corium with apical margin almost straight, apex reaching extreme base of laterotergite VI at rest. Posterior tibia straight, its length divided by that of posterior femur about 0.83.

Abdominal sternites III–VII with posterolateral angles drawn out into spines (Fig. 106) which are directed posteriorly as in *C. elongata*. Male genital capsule with lip broad, tongue acute; paramere (Fig. 109) with apical margin slightly concave. Aedeagus with sclerites protecting base of vesica longer than those of *C. elongata*; conjunctiva with all lobes membranous; paired apical ventral and distal ventrolateral lobes present, distal dorsolateral and ventral lobes absent, dorsomedian lobe low, flat-topped, distal dorsomedian lobe obsolete, intermediate dorsomedian lobe present, slightly larger than dorsomedian lobe. Female genitalia generally similar to those of *C. elongata* but spermatheca (Fig. 105) with bulb longer, narrow part of duct less convoluted and broad part of duct longer.

Sculpture and pilosity generally as in *C. elongata* but short, decumbent, white pubescence forming four more or less distinct longitudinal lines on dorsal surface of head, three very distinct longitudinal lines on pronotum and three to five distinct lines along scutellum; sides of head, thoracic pleura and sides of abdominal sterna each with two oblique lines of similar white pubescence. Scutellum much less densely pubescent than in *C. elongata*.

Head, thorax, abdomen, femora and antennal segment I dark red-brown; spines of pronotum and at sides of abdomen black; antennal segments II–VI yellow-brown with IV infusate; tibiae and tarsi stramineous, all tibiae with distinct basal annulus piceous to black, tarsi and apices of tibiae infusate. Clavus and corium bright orange-brown, clavus with median piceous stripe, corium with a narrow stripe along part of *R* and a broad, irregular stripe along parts of *Cu*, *M* and apical margin piceous; membrane milky white, veins boldly marked with chocolate brown.

REMARKS. The male specimen from Ethiopia has the posterolateral angles stouter and the pronotal spines and granules less pronounced than in the other specimens seen. The holotype is figured by Distant (1909 : pl. 2, fig. 7).

DISTRIBUTION. Highlands of East Africa.

MATERIAL EXAMINED

Acanthomia insignis Distant, holotype ♀, **Uganda**: Ruwenzori, 5600 ft (1700 m) (*G. F. Scott-Elliot*) (BMNH, London).

Ethiopia: 1 ♂, Borodda, 2500 m, 18–19.xi.1948 (*H. Scott*) (BMNH, London). **Zaire**: 1 ♂, 1 ♀, Kivu, Butembo, ix–x.1965 (*P. Célis*) (MRAC, Tervuren).

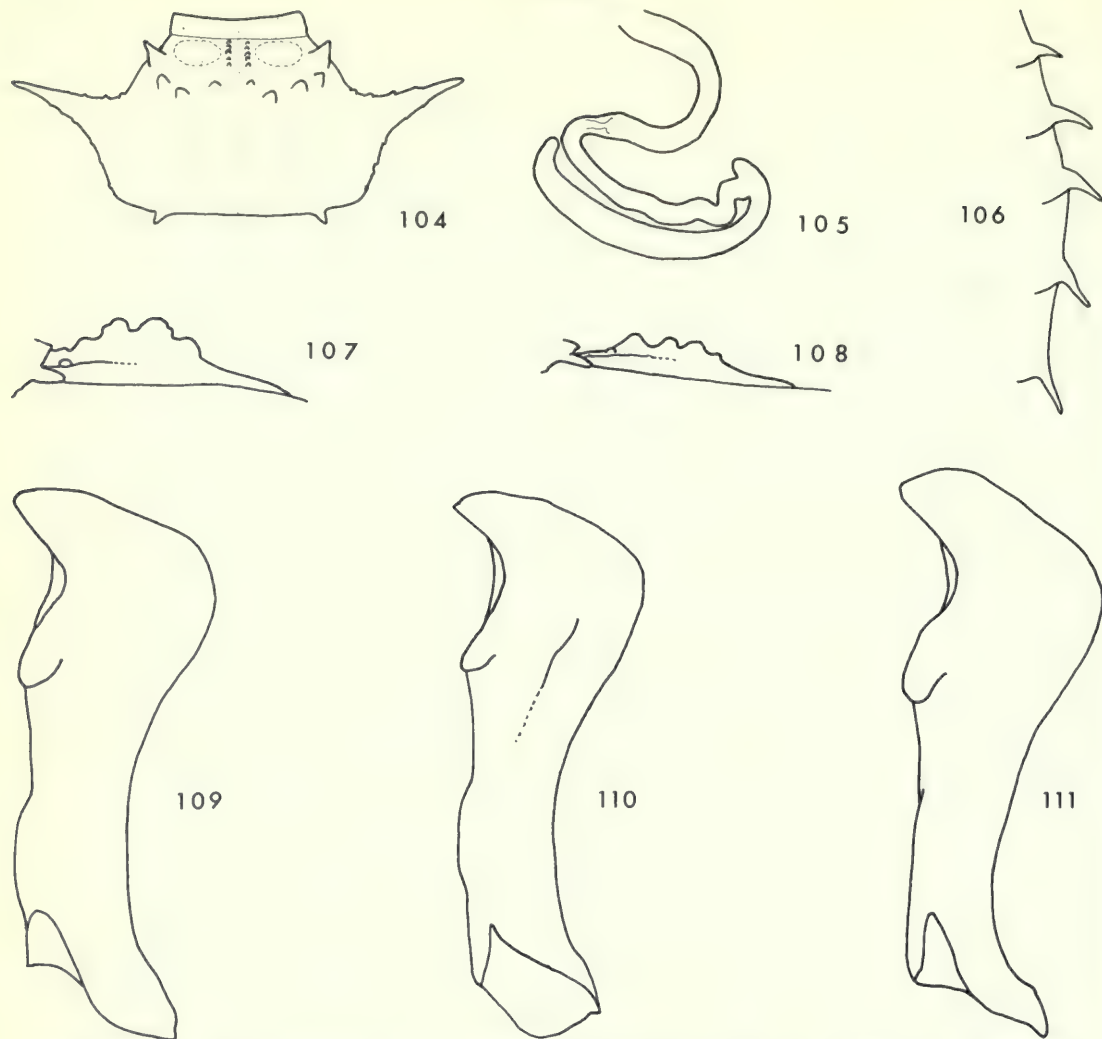
Clavigralla minor (Schouteden) **comb. n., stat. n.**

(Fig. 110)

Acanthomia insignis forma *minor* Schouteden, 1938 : 290. **LECTOTYPE** ♂, **BURUNDI** (MRAC, Tervuren), here designated [examined].

Length: ♂, 8.1 mm ($n = 1$); ♀, 8.6 mm ($n = 1$). Very similar to *C. insignis* but smaller.

Ratio of lengths of antennal segments I : II : III : IV in male as 1.00 : 0.85 : 0.85 : 0.89, in female as 1.00 : 0.83 : 0.87 : 0.87; length of segment I divided by width of head including eyes in male 1.39 ($n = 1$), in female 1.32 ($n = 1$). Ratio of lengths of rostral segments I : II : III : IV in male as 1.00 : 0.87 : 0.63 : 0.99, in female as 1.00 : 0.87 : 0.69 : 0.99.



Figs 104–111 *Clavigralla* species. (104) *insignis*, ♂, pronotum, dorsal view; (105) same, holotype ♀, spermatheca, dorsal view; (106) same, ♂, lateral margin of abdominal sternites III–VII, ventral view; (107) same, holotype ♀, scutellum, left lateral view; (108) *andersoni*, holotype ♂, scutellum, left lateral view; (109) *insignis*, left paramere, dorsal view; (110) *minor*, lectotype, left paramere, dorsal view; (111) *andersoni*, holotype, left paramere, dorsal view.

Width of pronotum across apices of posterolateral spines divided by width of head including eyes in female 2.59 ($n = 1$), male pronotum damaged.

Paramere of male (Fig. 110) with apical margin convex and shaft proportionately longer than in *C. insignis*.

Sculpture, pubescence and coloration as in *C. insignis*.

REMARKS. Because of the difference in the shape of the paramere this 'form' is treated as a full species, distinct from *C. insignis*.

DISTRIBUTION. Known only from the type-locality in Burundi.

MATERIAL EXAMINED

Acanthomia insignis minor Schouteden, lectotype ♂, **Burundi**: Kitega, xi.1935 (*P. Lefèvre*) (MRAC, Tervuren).

Burundi: 1 ♀, same data as lectotype (paralectotype of *Acanthomia insignis minor*) (MRAC, Tervuren).

Clavigralla andersoni sp. n.

(Figs 108, 111)

Length: ♂, 9.4 mm ($n = 1$). Very similar to *C. insignis*. Known only from the male holotype.

Ratio of lengths of antennal segments I : II : III : IV as 1.00 : 0.83 : - : - (segments III and IV missing); length of segment I divided by width of head including eyes 1.42. Ratio of lengths of rostral segments I : II : III : IV as 1.00 : 0.88 : 0.62 : 0.96.

Posterolateral angles of pronotum directed more anteriorly than in *C. insignis*; width across apices of posterolateral spines divided by width of head including eyes 2.58. Scutellum (Fig. 108) weakly convex. Length of posterior tibia divided by length of posterior femur 0.87.

Paramere of male (Fig. 111) with apical margin strongly oblique.

Dark markings of clavus, corium and membrane veins much less evident than in *C. insignis*.

REMARKS. Differs from *C. insignis* chiefly in the form of the scutellum and the paramere.

DISTRIBUTION. East Africa.

MATERIAL EXAMINED

Holotype ♂, 'British East Africa' (T. J. Anderson) (BMNH, London).

Clavigralla angolensis sp. n.

(Figs 112-114)

Length: ♂, 8.1 mm ($n = 1$). Similar to *C. elongata* and *C. insignis* but smaller and with posterolateral angles of abdominal sternites III-VII produced almost perpendicularly to sides of body. Known only from the male holotype.

Ratio of lengths of antennal segments I : II : III : IV as 1.00 : 0.80 : 0.78 : 0.89; length of segment I divided by width of head including eyes 1.42. Ratio of lengths of rostral segments I : II : III : IV as 1.00 : 0.87 : 0.69 : 1.04.

Pronotum (Fig. 112) strongly declivent, posterolateral angles strongly produced and directed slightly forwards; width across apices of posterolateral spines divided by width of head including eyes 2.95; disc with a slender spine near middle of each anterolateral margin and a few very short spines behind these. Scutellum strongly convex, biseriately granulate longitudinally. Corium with apical margin almost straight, at rest with apex reaching to level of base of laterotergite VI. Length of posterior tibia divided by length of posterior femur 0.81.

Abdominal sternites III-VII with posterolateral angles produced laterad into rather slender spines standing almost at right angles to the line of the abdominal margin (Fig. 113). Male genital capsule with lip broad, tongue acute; paramere (Fig. 114) rather thick, apical margin short and oblique.

Pubescence and colour pattern as in *C. insignis* except that ground colour of head, thorax, abdomen, antennal segment I and femora is orange-brown, the same colour as clavus and corium; femora with a few, obscure, paler markings in apical third; tibiae with basal annuli orange-brown, not black.

REMARKS. Easily distinguished from the other species of the *C. elongata* and *C. insignis* groups by the combination of almost perpendicular abdominal marginal spines with the small size.

DISTRIBUTION. Known only from the type-locality in Angola.

MATERIAL EXAMINED

Holotype ♂, Angola: Capeio, 22.vii.1931 (Mrs W. P. Cockerell) (BMNH, London).

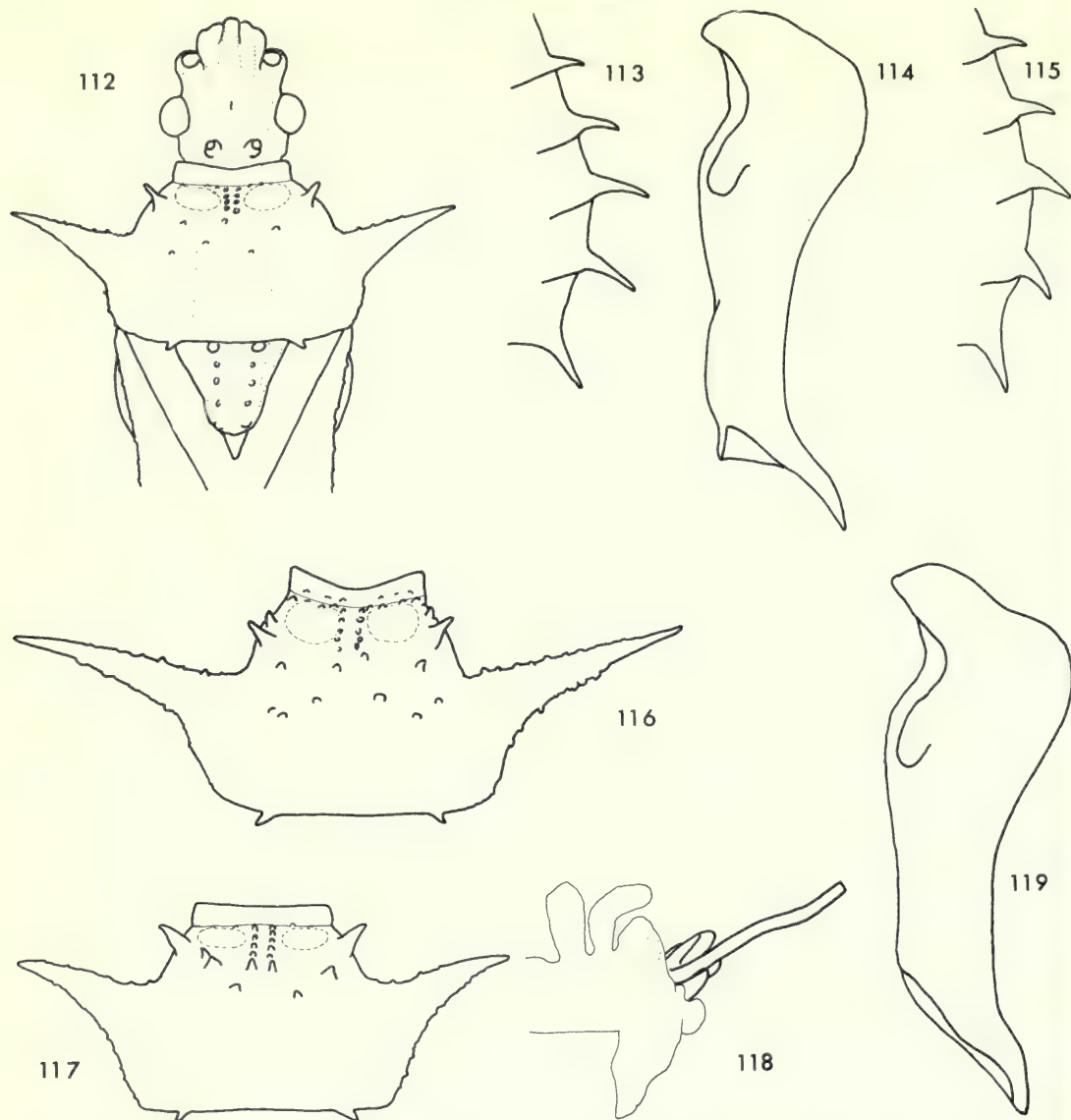
Clavigralla egregia sp. n.

(Fig. 116)

Length: ♀, 9.5 mm ($n = 1$). Similar to *C. insignis* but differs in the longer, laterally directed posterolateral spines of the pronotum and abdominal sterna. Known only from the female holotype.

Ratio of lengths of antennal segments I : II : III : IV as 1.00 : 0.75 : 0.72 : 0.76; length of segment I divided by width of head including eyes 1.74. Ratio of lengths of rostral segments I : II : III : IV as 1.00 : 0.93 : 0.61 : 1.00.

Pronotum (Fig. 116) with posterolateral angles very strongly produced laterally, width across apices of posterolateral spines divided by width of head including eyes 3.97; disc with several small, blunt spines



Figs 112–119 *Clavigralla* species. (112) *angolensis*, holotype ♂, head, pronotum and scutellum, dorsal view; (113) same, lateral margins of abdominal sternites III–VII, ventral view; (114) same, left paramere, dorsal view; (115) *aculeata*, holotype ♂, lateral margins of abdominal sternites III–VII, ventral view; (116) *egregia*, holotype ♀, pronotum, dorsal view; (117) *aculeata*, holotype ♂, pronotum, dorsal view; (118) same, paratype ♂, conjunctiva and vesica, left lateral view; (119) same, paratype ♂, left paramere, dorsal view.

and one larger, slender spine near the middle of each anterolateral margin. Corium with apical margin straight, at rest with apex reaching to level of base of laterotergite VI. Posterior tibia straight, 0.81 times as long as posterior femur.

Abdominal sternites III–VII with posterolateral angles drawn out laterally into spines almost perpendicular to lateral margin of abdomen. Spermatheca and female genital sclerites as in *C. shadabi* (cf. Fig. 69).

Coloration, pilosity and sculpturing as in *C. insignis*.

REMARKS. Distinguished from similarly coloured species of this group by the very elongate pronotal posterolateral angles, and from all except *C. angolensis* by the radiating abdominal spines.

DISTRIBUTION. Known only from the type-locality in Malawi.

MATERIAL EXAMINED

Holotype ♀, **Malawi**: Mlanje, 17.iii.1913 (*S. A. Neave*) (BMNH, London).

Clavigralla longispina sp. n.

Length: ♂, 8.7 mm ($n = 1$); ♀, 9.2–9.5 mm, mean 9.3 mm ($n = 3$). Closely allied to *C. insignis* which it very closely resembles in appearance and coloration.

Ratio of lengths of antennal segments I : II : III : IV in both sexes about 1.00 : 0.76 : 0.75 : – (IV missing in all examples seen); length of segment I divided by width of head including eyes in male 1.53 ($n = 1$), in female 1.32–1.48 ($n = 2$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.87 : 0.59 : 0.95.

Pronotum with posterolateral angles strongly produced, width across apices of posterolateral spines divided by width of head including eyes in male 3.25 ($n = 1$), in female 3.02–3.16 ($n = 2$). Length of posterior tibia divided by length of posterior femur in both sexes 0.80–0.83, mean 0.82 ($n = 4$).

Abdominal sternites III–VII with posterolateral angles produced into spines which are longer and less posteriorly directed than in *C. insignis*. Male paramere indistinguishable from that of *C. insignis*; intermediate dorsal lobe of conjunctiva rather long.

Coloration, sculpture and distribution of pubescence as described for *C. insignis* except that basal annuli of tibiae are red-brown and femora bear pale marmoration in their apical thirds.

REMARKS. Distinguished from *C. insignis* chiefly in the form of the posterolateral spines of the pronotum and abdominal sternites.

DISTRIBUTION. Southern Zaire and northern Zambia.

MATERIAL EXAMINED

Holotype ♂, **Zambia**: Lower Kalungwisi Valley, 1100 m, dense forest, 12–13.ix.1908 (*S. A. Neave*) (UM, Oxford).

Paratypes. **Zaire**: 1 ♀, Bandundu, Malongi, vi.1943 (*H. J. Bredo*) (IRSNB, Brussels). **Zambia**: 1 ♀, Chisanga Plateau, Kalungwisi District, 1400 m, 25.ix.1908 (*S. A. Neave*); 1 ♀, N. Lake Bangweolo, Luwingu, 1300 m, 3.vi.1908 (*S. A. Neave*) (UM, Oxford).

Material excluded from type-series. **Zaire**: 1 ♀, 62 km NE. of Lubumbashi (Elizabethville), 1225 m, 22.i.1958 (*E. S. Ross*, *R. E. Leech*) (CAS, San Francisco). (Received after description was prepared.)

Clavigralla aculeata sp. n.

(Figs 115, 117–119)

Length: ♂, 8.75–9.1 mm ($n = 2$); ♀, 9.6–10.0 mm, mean 9.8 mm ($n = 3$). Rather similar to *C. insignis* in general appearance and coloration.

Antennifers moderately divergent. Ratio of lengths of antennal segments I : II : III : IV in male (1 specimen only) as 1.00 : 0.82 : 0.85 : 0.95; in female (1 specimen only) as 1.00 : 0.86 : 0.90 : 0.82; length of segment I divided by width of head including eyes in male 1.48–1.49 ($n = 2$), in female 1.39–1.45, mean 1.42 ($n = 3$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.88 : 0.70 : 1.01.

Pronotum (Fig. 117) about as steeply declivent as in *C. elongata*, with posterolateral angles directed more strongly forwards; disc with stouter, stronger spines than in *C. insignis* or *C. elongata*; width across apices of posterolateral spines divided by width of head in male 2.68–2.84 ($n = 2$), in female 2.58–2.86, mean 2.69 ($n = 3$). Scutellum strongly convex, with two longitudinal rows of 3–4 short, blunt tubercles. Corium with apex distinctly but shortly produced, its apex at rest reaching posteriorly to level of base of laterotergite VI. Anterior and intermediate femora each with a small subapical spine beneath, posterior femur with two major subapical spines, some very small spines between them and an apical series of four spines. Posterior tibia straight, its length divided by that of posterior femur in both sexes 0.82–0.84, mean 0.83 ($n = 5$).

Abdominal sternites III–VII with posterolateral angles (Fig. 115) produced into strong spines which are slightly but distinctly curved posteriad and more nearly perpendicular to lateral margins of abdomen than

are those of *C. elongata* and *C. insignis*. Male genital capsule with lip broad, paramere (Fig. 119) of similar shape to that of *C. insignis*. Conjunctiva (Fig. 118) with ventral apical lobes and distal ventrolateral lobes developed as in *C. elongata*, dorsomedian lobe low, flat-topped, distal dorsomedian lobe very weakly developed, narrow intermediate dorsal lobe present between dorsomedian and distal dorsomedian lobes, distal dorsolateral lobes absent. Spermatheca as in *C. insignis* (cf. Fig. 105) except that the part of the duct between the 'valve' and the junction with the gynatrium is shorter. Sclerites of wall of gynatrium as in *C. shadabi* (cf. Fig. 69).

Resembles *C. insignis* in distribution of pubescence and in colour pattern but head, thorax, abdomen, femora and antennal segment I paler, gingery brown, and brown markings of clavus and corium less intense.

REMARKS. Distinguished from *C. insignis* by stouter spines of pronotal disc, paler colour and differently shaped abdominal spines and from *C. angolensis* by the shorter pronotal posterolateral spines. Rather similar in appearance to *C. horrida* but lacks the long spines on the scutellum and the additional femoral spines.

DISTRIBUTION. South Africa.

MATERIAL EXAMINED

Holotype ♂, **South Africa**: Natal, Estcourt, 1896 (BMNH, London).

Paratypes. **South Africa**: 1 ♂, 2 ♀, Natal, Estcourt, 1896 (BMNH, London); 1 ♀, Transvaal, Zoutpansberg, 800 m, -x.- (*Schouteden*) (MRAC, Tervuren).

Clavigralla horrida (Germar) nec auctt. post.

(Figs 120–125)

[*Alydus acantharis* (Fabricius); Thunberg, 1822 : 1. Misidentification based on specimen now at University of Uppsala, examined.]

[*Cimex acantharis* Linnaeus; incorrectly cited in synonymy with *Alydus acantharis* (Fabricius) by Thunberg, 1822 : 1.]

Syromaster horridus Germar, 1840 : 145. LECTOTYPE ♀, SOUTH AFRICA (MNHU, Berlin), here designated [examined].

Clavigralla muricata Stål, 1855 : 31. LECTOTYPE ♂, SOUTH AFRICA (NR, Stockholm), here designated [examined]. [Synonymized with *Clavigralla acantharis* (Fabricius) sensu Thunberg by Stål, 1866 : 108.]

Syn. n. of *horrida*.

[*Clavigralla acantharis* (Fabricius) sensu Thunberg; Stål, 1866 : 108.]

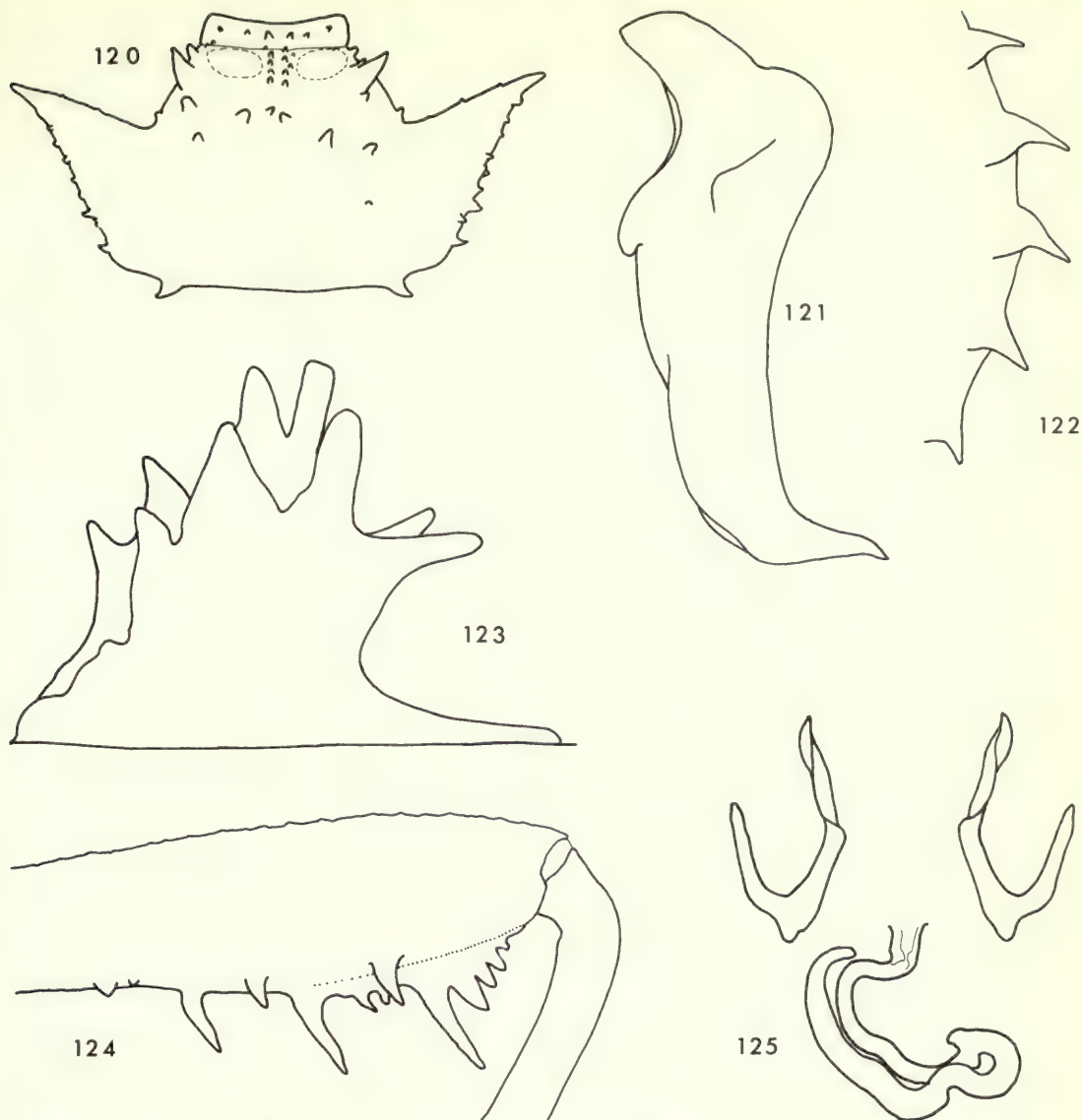
Acanthomia muricata (Stål); Stål, 1873 : 83.

(The binomen *Clavigralla horrida* (Germar) was first used by Stål, 1866 : 108 for the species treated above under the name of *C. elongata* Signoret, q.v.)

Length: ♂, 8.4–9.8 mm, mean 9.2 mm ($n = 12$); ♀, 9.7–11.0 mm, mean 10.5 mm ($n = 13$). Related to *C. elongata* but body form more robust.

Antennifers moderately divergent. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.91 : 0.76 : 0.70, in female about 1.00 : 0.94 : 0.78 : 0.70; length of segment I divided by width of head including eyes in male 1.51–1.81, mean 1.65 ($n = 13$), in female 1.44–1.67, mean 1.54 ($n = 13$). Ratio of lengths of rostral segments I : II : III : IV in male about 1.00 : 0.94 : 0.56 : 0.80, in female about 1.00 : 0.90 : 0.54 : 0.76.

Pronotum (Fig. 120) with two prominent, stout spines near middle of anterolateral margins and some smaller ones on disc, some of these arranged in a semicircle terminating anteriorly at the two larger spines; posterolateral angles strongly produced anterolaterally and moderately elevated, each terminating in a short spine; width across apices of posterolateral spines divided by width of head including eyes in male 2.41–2.86, mean 2.64 ($n = 11$), in female 2.65–3.07, mean 2.86 ($n = 13$). Scutellum (Fig. 123) strongly elevated with two longitudinal rows of up to 5 stout, erect spines. Corium with apex very slightly produced, at rest reaching posteriorly to level of suture between laterotergites V and VI. Anterior and intermediate femora each with a single subapical spine beneath; posterior femur (Fig. 124) with 3–4 major subapical spines, sometimes 1 or 2 minor spines between prepenultimate and penultimate major spines and between penultimate and last major spines, an apical series of 4 spines and also with a subapical row of up to 3 small spines on posterior edge of lower face of femur. Posterior tibia straight, its length divided by that of posterior femur in both sexes 0.87–0.96, mean 0.91 ($n = 25$).



Figs 120–125 *Clavigralla horrida*. (120) ♀ pronotum, dorsal view; (121) left paramere, dorsal view; (122) lateral margins of ♀ abdominal sternites III–VII, ventral view; (123) lectotype, scutellum, left lateral view; (124) apex of ♀ right posterior femur, posterior view; (125) spermatheca and sclerites of dorsal wall of gynatrium, dorsal view.

Abdominal sternites III–VII with posterior angles (Fig. 122) produced into broad spines which are much less strongly deflected posteriorly than those of *C. elongata*. Male genital capsule with lip broad, tongue entire; paramere (Fig. 121) with apical margin slightly sinuate. Aedeagus with long, membranous distal dorsolateral lobes, resembling aedeagus of *C. shadabi* (cf. Fig. 70). Spermatheca (Fig. 125) with duct only about as long as bulb, portion of duct between 'valve' and gynatrium very short. Process at apex of second valvula bifid with the lower part of the fork shorter than the upper.

Sculpture of integument as in *C. elongata* but more pronounced on pronotum, where granules on area around posterolateral angles are developed into small, black-tipped spines or tubercles. Pilosity generally as in *C. elongata* but colour of hairs dead white and hairs organized into two more or less distinct longitudinal broad bands on pronotum with a fine band between them along midline. Pubescence of

pronotum otherwise sparse. Colour of head, thorax and abdominal sternites red-brown with piceous markings as in *C. elongata*; spines of pronotum, scutellum and abdominal margins black, at least at apex; antennal segments I and IV, femora and basal annuli of tibiae uniform red-brown; remainder of tibiae, clavus and corium pinkish yellow; antennal segments II and III red. Membrane of hemelytra milky white, its veins in part brown but contrast in colour between membrane and veins not nearly as pronounced as in *C. insignis* and its close allies.

REMARKS. The long, outstanding spines of the scutellum at once distinguish this species from all others in the genus.

DISTRIBUTION. Rhodesia and South Africa.

MATERIAL EXAMINED

Syromaster horridus Germar, lectotype ♀, **South Africa**: 'Promontorium Bonae Spei' (*C. F. Drège*) (MNHU, Berlin). *Clavigralla muricata* Stål, lectotype ♂, **South Africa** 'Cap. B. Spei' (*Victorin*) (NR, Stockholm) [Stål, 1855 : 31 cites locality as 'in terra Natalensi'].

Rhodesia: 1 ♂, Vumba Mts, xii.1933 (NM, Bulawayo). **South Africa**: 1 ♀, 'Caffraria' (NR, Stockholm); 1 ex., 'Caput Bonae Spei' [det. by *C. P. Thunberg* as *Alydus acantharis*] (University of Uppsala); 1 ♂, 1 ♀, 'C.G.H.'; 1 ♂, 1 ♀, 'Cape'; 1 ♂, 'S. Africa' (BMNH, London); 1 ♀, 'British Caffraria Castilneau 1862' (UM, Oxford); 1 ♂, Natal, Cathedral Peak, 18.xii.1966 (*J. G. H. Londt*) (TM, Pretoria); 1 ♀, Cape Prov., Grootvatersbosch, For. Res. 22 km N. of Heidelberg, 5.ii.1968 (*Schuh, Slater, Sweet & Slater*) (Slater coll.); 1 ♂, Cape Prov., Simonstown, ii.1893 (*P. de la Garde*) (UM, Oxford); 1 ♀, Cape Prov., 21 km E. of Gansbaai, 2.ii.1968 (*J. A. & S. Slater & M. Sweet*) (PPRI, Pretoria); 1 ♂, 2 ♀, Cape Prov., Stellenbosch, 5.xi.1925 (*H. Brauns*); 1 ♂, 1 ♀, Cape Prov., Swellendam, 17.xii.1931–18.i.1932 (*R. E. Turner*); 1 ♀, no data; 8 ♂, 9 ♀, Cape Prov., Ceres, 450 m, xii.1920, i.1921, ii.1921, 2–21.iii.1921, 1–12.xi.1924, xii.1924, ii.1925 (*R. E. Turner*) (BMNH, London); 1 ♀, Cape Prov., Pearl, 16.xi.1949 (*Malkin*); 1 ♂, Cape Prov., Du Toits Kloof, 22.xi.1949 (*B. Malkin*) (CAS, San Francisco).

Clavigralla natalensis Stål

(Figs 126–130)

Clavigralla natalensis Stål, 1855 : 31. LECTOTYPE ♀, SOUTH AFRICA (NR, Stockholm), here designated [examined].

Acanthomia natalensis (Stål) Stål, 1873 : 83.

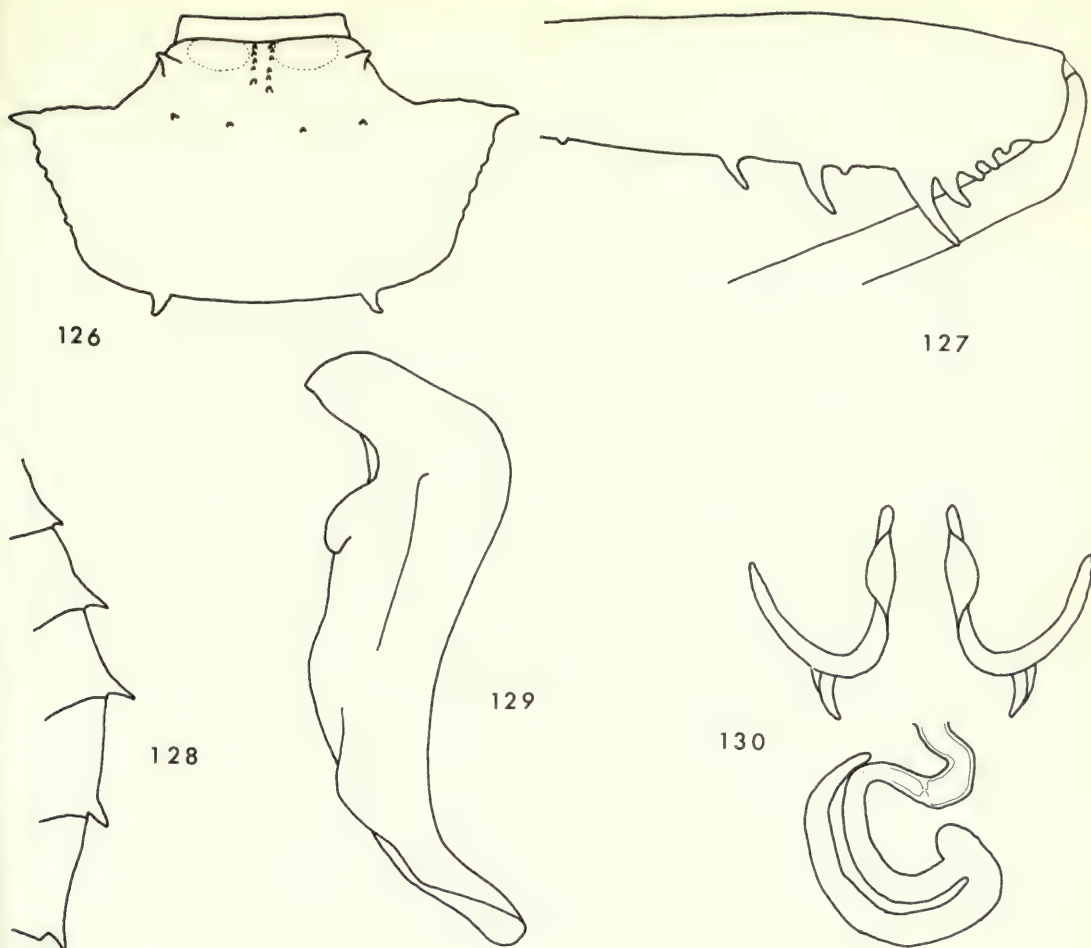
Length: ♂, 9.2–10.4 mm, mean 9.9 mm ($n = 4$); ♀, 10.6–12.0 mm, mean 11.8 mm ($n = 14$). The most robust of the species allied to *C. elongata*.

Antennifers moderately divergent. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.86 : 0.80 : 0.92, in female about 1.00 : 0.85 : 0.78 : 0.85 (figure for male segment IV is based on only two observations and is the mean of 0.82 and 1.02); length of segment I divided by width of head including eyes in both sexes 1.16–1.38, mean 1.27 ($n = 18$). Ratio of lengths of rostral segments I : II : III : IV in male about 1.00 : 0.97 : 0.71 : 1.06, in female about 1.00 : 0.90 : 0.67 : 1.00.

Pronotum (Fig. 126) strongly declivent, with a semicircle of small spines on disc, posterolateral angles much less strongly produced than in related species, tipped with short spines; width across apices of posterolateral spines divided by width of head including eyes in male 2.39–2.69, mean 2.53 ($n = 4$), in female 2.43–2.77, mean 2.62 ($n = 14$). Scutellum slightly longer than broad, weakly convex, with two longitudinal rows of large granules. Corium with apex produced, at rest reaching posteriorly to about one-third of the way along laterotergite VI. Anterior and intermediate femora each with a strong subapical spine beneath; posterior femur (Fig. 127) with 3–5 major spines beneath, increasing in length towards apex of femur, without minor spines between them, apical series of 4 spines present but no additional posterior row of spines (cf. *C. horrida*). Posterior tibia straight, its length divided by that of posterior femur in both sexes 0.83–0.92, mean 0.88 ($n = 18$).

Abdominal sternites III–VII with posterior angles (Fig. 128) produced into short, posteriorly directed spines. Male genital capsule with lip broad, tongue entire; paramere (Fig. 129) stout. Conjunctiva generally as in *C. elongata* except for distal dorsomedian lobe, which is lower. Female with bifid apical process of second valvula well developed. Spermatheca (Fig. 130) with bulb narrow and duct short, sclerites of dorsal wall of gynatrium (Fig. 130) slender.

Sculpture of integument generally as in *C. elongata* but granulation everywhere weaker. Pubescence of head, pronotum, scutellum, thoracic pleura, thoracic and abdominal sterna, femora and antennal segment I almost uniform, consisting of short, colourless, suberect to erect hairs interspersed with short, decum-



Figs 126-130 *Clavigralla natalensis*. (126) pronotum of ♀, dorsal view; (127) apex of left posterior femur, anterior view; (128) lateral margin of ♂ abdominal sternites III-VII, ventral view; (129) left paramere, dorsal view; (130) spermatheca and sclerites of dorsal wall of gynatrium, dorsal view.

bent, white, curled but not tomentose hairs, organized into a thin, sometimes indistinct line along midline of pronotum and a line on each side of vertex contiguous with each eye. Clavus, corium and abdominal laterotergites with similar but shorter and sparser pubescence of both types; antennal segments II-IV, tibiae and tarsi with short, suberect pubescence interspersed with very short, indistinct, decumbent pubescence. Colour largely red-brown; antennae with segments I-III paler and segment IV darker than general body coloration; abdominal sternites slightly paler; clavus and corium testaceous, veins coloured brown or red-brown, especially in anterior and distal areas of corium, membrane very pale fuscous, its veins brown, uninterrupted; all tibiae stramineous with basal annulus piceous and apical annulus red-brown.

REMARKS. A distinctive species by reason of the heavy build and the shape of the pronotum.

DISTRIBUTION. Africa south of the Zambesi river.

MATERIAL EXAMINED

Clavigralla natalensis Stål, lectotype ♀, **South Africa:** 'Caffraria' (*J. Wahlb.*) (NR, Stockholm).

Rhodesia: 1 ♀, Mashonaland, Salisbury, 1898 (BMNH, London). **South Africa:** 1 ♂, Transvaal, Johannesburg E., Bedford Ridge, 25.x.1953 (*A. L. Capener*) (Slater coll.); 1 ♀, Johannesburg, 5.ii.1958

(*Capener*) (Slater coll.); 1 ♂, Johannesburg, 1800 m, x.1898 (*J. P. Cregoe*); 1 ♀, Johannesburg, 1800 m, vi.1899 (*Cregoe*); 1 ♀, Johannesburg, 1.v.1905 (*Cregoe*); 1 ♂, Transvaal, Klerksdorp, Snowball, ix.1899; 1 ♂, Transvaal, Lydenberg District (BMNH, London); 2 ♀, Orange Free State, Bothaville (*Dr Brauns*) (TM, Pretoria); 2 ♀, Natal, Pietermaritzburg, 1902 (*Cregoe*); 1 ♀, Natal, Drakensberg, Van Reenen, 1-22.i.1927 (*R. E. Turner*); 1 ♀, Natal, Estcourt, viii.1895; 1 ♀, Natal, Howick, 1806; 1 ♀, Howick (BMNH, London); 1 ♂, Transvaal, Vee kraal, 14.xii.1963 (*A. L. Capener*) (PPRI, Pretoria); 1 ♀, Natal, Bray Hill, viii, Gram (BMNH, London).

The *tomentosicollis*-group

Antennifer with apical process long, deflexed; metathoracic peritreme with dorsal ridge entire; tongue of male genital capsule trifold, bifid or entire; lip of genital capsule filling posterior emargination in posterior view; pubescence of anterior, declivent area of pronotum contrasting strongly in form and colour with that of posterior, horizontal part. Second valvula of ovipositor variously shaped but never with apical appendage. Pronotum with posterolateral angles not or relatively weakly prominent, posterolateral spines arising abruptly from them.

The *leontjevi*-subgroup

Tongue of male genital capsule entire; pronotal disc without sublateral tubercles; membrane of hemelytron unpigmented.

Clavigralla leontjevi (Bergróth) comb. n.

(Figs 131-136)

Acanthomia leontjevi Bergróth, 1908 : 107. LECTOTYPE ♂, ETHIOPIA (ZMU, Helsinki), here designated [examined].

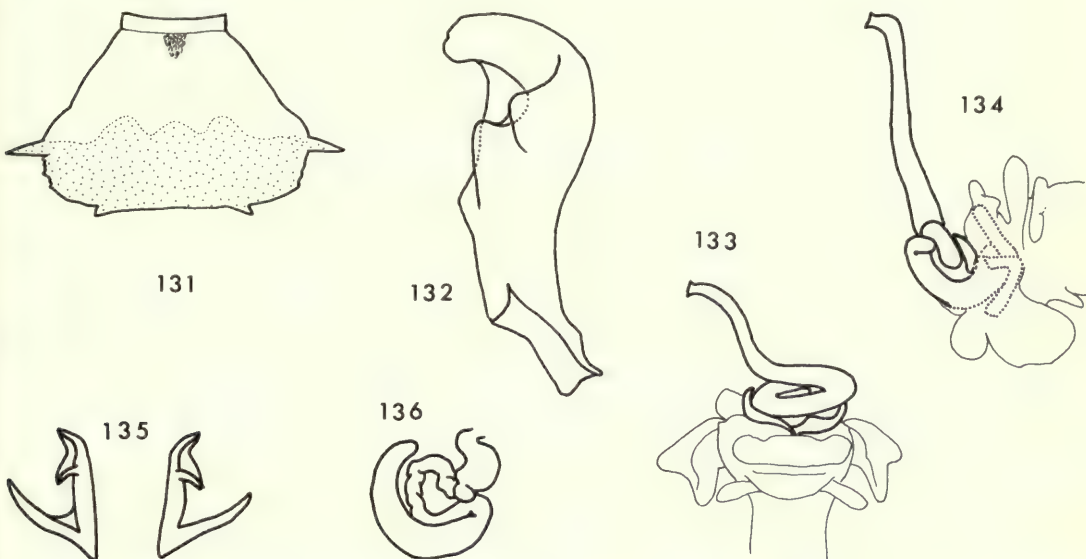
Length: ♂, 6.0-7.1 mm, mean 6.6 mm ($n = 22$); ♀, 5.9-7.5 mm, mean 6.9 mm ($n = 21$). A small insect, similar in appearance to a small *C. tomentosicollis*.

Head subquadrate; antennifers very slightly divergent. Length of antennal segment I divided by width of head including eyes in male 1.07-1.29, mean 1.21 ($n = 22$), in female 1.06-1.30, mean 1.17 ($n = 21$). Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.78 : 0.66 : 1.00, in female about 1.00 : 0.78 : 0.67 : 0.96. Length of basal segment of rostrum divided by width of head including eyes in male 0.60-0.72, mean 0.65 ($n = 20$), in female 0.61-0.69, mean 0.66 ($n = 16$). Ratio of lengths of rostral segments I : II : III : IV in male about 1.00 : 0.91 : 0.63 : 0.95, in female about 1.00 : 0.88 : 0.60 : 0.91.

Pronotum (Fig. 131) with posterolateral angles bearing slender spines directed laterally or slightly antero- or posterolaterally, spines gently upcurved; width of pronotum across apices of spines divided by width of head including eyes in male 2.36-2.95, mean 2.54 ($n = 18$), in female 2.34-3.00, mean 2.55 ($n = 18$). Disc of pronotum with a cluster of granules in anterior part of midline but completely without projecting tubercles or spines, even near lateral margins. Scutellum strongly convex. Anterior and intermediate femora each with 0-1 subapical spine beneath; posterior femur with 2 major subapical spines beneath, the second about one and one-half times as long as the first, about 5 small spines present between the major spines and a terminal series of four spines present. Posterior tibia distinctly curved at base, length of posterior tibia divided by length of posterior femur in male 0.66-0.74, mean 0.70 ($n = 21$), in female 0.64-0.74, mean 0.69 ($n = 19$). Apex of corium at rest reaching to level of suture between laterotergites V and VI.

Abdominal sternites III-VII with posterolateral angles produced into well-developed, acute spines, each spine about one-third as long as lateral margin of corresponding sternite. Male genital capsule with tongue broadly rounded distally; paramere (Fig. 132) with apex strongly inflexed and with two well-developed teeth on blade, the distal one more strongly sclerotized than the other and sited on the dorsal face. Aedeagus (Figs 133, 134) with vesica long, sclerites at its base large, together almost as wide as conjunctiva. Conjunctiva with dorsomedian lobe very low, its lateral angles strongly produced, intermediate dorsal lobe separated from distal dorsomedian lobe, which is weakly developed as are distal dorsolateral lobes; distal ventrolateral lobes the largest, apical ventral and ventral lobes present; none of the lobes sclerotized. Female tergite IX apically deflexed, anus directed posteroventrally. Spermatheca (Fig. 136) with duct short, slightly convoluted and rather wide especially near junction with gynatrium. Sclerites of dorsal wall of gynatrium (Fig. 135) each with an anterolaterally directed spur arising from the longitudinal arm. Laterotergite VII clearly separated from mediotergite VII in both sexes.

Sculpture of integument as in *C. tomentosicollis*. Pubescence and coloration generally similar to those of *C. tomentosicollis*. Pale, declivent area of pronotum interrupted by a small patch of piceous granules in anterior midline; area of pale pubescence projecting posteriorly into the patch of darker pubescence behind it in four places, the two pale prominences nearest midline tending to project as backward sloping tufts and without a tuft of darker hairs between them; midline of posterior, dark brown area frequently with an incipient line of pale, silvery hairs. Hemelytral membrane slightly milky, hyaline, its only dark markings being two very small piceous or brown blotches on two veins at the point where these enter the membrane from the apical margin of the corium.



Figs 131–136 *Clavigralla leontjevi*. (131) pronotum of ♂, dorsal view; (132) left paramere, dorsal view; (133) conjunctiva and vesica, dorsal view; (134) same, left lateral view; (135) sclerites of dorsal wall of gynatrium, dorsal view; (136) spermatheca.

REMARKS. This species differs from all others in the genus in the complete absence of large tubercles or spines from the declivent area of the pronotum. Another unique feature is the partially deflexed tergum IX and anus of the female, approaching the condition which obtains in the genus *Gralliclava* in the Oriental region. The complete separation of laterotergites VII from mediotergite VII in the male is also unique. However, in most features this species accords well with the characters of the *tomentosicollis*-group of species. There is some variation in the pronotal posterolateral spines, which may be directed slightly anterolaterally, laterally or slightly posterolaterally, and in the amplitude of the undulations in the line marking the boundary between the pale and dark areas of pronotal pubescence. The male paramere is frequently slightly narrower than the example illustrated (Fig. 132), in which an incipient third tooth is visible on the ventromedian area of the blade at its junction with the shaft. This third tooth is usually not as strongly developed as that illustrated and may often be absent. From the material available it is not possible to make a definite statement as to the status of these variants but they do not appear to be correlated one with another, nor do they seem to vary consistently on a geographical basis. Risbec (1950; 1951; 1955) records the following Hymenoptera as parasites of the egg: *Anastatus aliberti* Risbec and *A. nezarae* Risbec (Eupelmidae), *Paravignalia hemipterae* Risbec (Pteromalidae) and *Gryon gnidus* Nixon (Scelionidae).

DISTRIBUTION. Africa between the Sahara desert and the Zambesi river.

MATERIAL EXAMINED

Acanthomia leontjevi Bergróth, lectotype ♂, **Ethiopia**: Adue, 1896 (other data illegible) (ZMU, Helsinki).

Senegal: 3 ♂, Bambeý, 29.i.1943, on potato (*J. Risbec*); 2 ♀, Bambeý, iv.1940 (*Risbec*) (BMNH, London). **Ivory Coast:** 2 ♂, Lamto (Toumodi), 24.vii.1964; 1 ♀, Lamto, 4.xii.1962 (BMNH, London). **Ghana:** 2 ♂, 3 ♀, Kintampo, 7.xii.1965 (*D. Leston*); 4 ♂, 1 ♀, Tafo, 3.i.1967, 21.i.1967, 13.ii.1967, 30.iii.1967, by pyrethrum knockdown from cocoa (*Theobroma*) (*R. Kumar, D. Leston*); 1 ♂, locality illegible, 7.x.1967 (*Leston*); 1 ♂, Twenadurasi, 28.i.1967 (*Leston*); 1 ♂, Tapa Amonya, Volta Region, 3.xi.1967; 1 ♀, Prampram, 27.viii.1966 (UG, Legon). **Togo:** 1 ♀, Missahoué, 650 m, vi.1963 (*Mme Y. Schach*) (MRAC, Tervuren). **Nigeria:** N. Nigeria, Chafe, 7.vii.1977 (*J. C. Deeming, A. O. Medaiyedu*); 1 ♀, Zaria, Samaru, 12.i.1970 (*J. C. Deeming*) (IAR, Samaru); 1 ♀, Ilorin, 13.xii.1929, on cotton (*Gossypium*) (*F. D. Golding*); 1 ♂, 2 ♀, Jos, 9.i.1956 (*Bechyne*) (BMNH, London). **Zaire:** 1 ♀, Faradje, 29° 40' E, 3° 40' N, xii.1912 (*Lang, Chapin*) (AMNH, New York); 1 ♂, Ngowa, 5.vi.1939 (*R. P. J. Mertens*); 2 ♂, Musoa, vi–vii.1939, xi.1939 (*H.-J. Brédo*) (IRSNB, Brussels). **Angola:** 2 ♀, no exact data (*Welwitsch*) (BMNH, London and Duarte coll.). **Sudan:** 1 ♂, 2 ♀, Blue Nile, Singa-Damazin, 15–17.xi.1962 (*R. Linnavuori*) (BMNH, London). **Kenya:** 1 ♀, Kisumu, 1143 m, xi.1920 (*Gedye*); 1 ♂, Thika, ix.1936 (*F. J. Gedye*) (BMNH, London). **Tanzania:** 1 ♂, E. Rukwa, 1050 m, iv.1938 (*D. G. McInnes*); 1 ♂, Urikiriguru, 25.viii.1958 (*I. A. D. Robertson*); 1 ♀, Urikiriguru, 19.ix.1958, on cotton (*Gossypium*) (*Robertson*) (BMNH, London). **Malawi:** 1 ♀, Valley of N. Rukuru, Karonga District, 600–1200 m, 15–18.vii.1910 (*S. A. Neave*) (BMNH, London). **Zambia:** 1 ♀, Abercorn, 15.xii.1943 (*H.-J. Brédo*) (IRSNB, Brussels). **Rhodesia:** 1 ♀, Lomagundi, vi.1929 (*A. Cuthbertson*) (NM, Bulawayo).

Clavigralla griseola (Linnavuori) **comb. n.**

Acanthomia griseola Linnavuori, 1978: 35. Holotype ♀, SOUTHERN YEMEN (Linnavuori coll.) [not examined].

This species was described too late to be included in the key. It is very close to *leontjevi*. I have seen a single ♀ paratype, from Eritrea. This specimen differs from *leontjevi* in the more intense dark markings, particularly those of the femora; the width of the pronotum divided by that of the head is only 2.29 and the antennae are longer, the length of segment I divided by width of head being 1.31. Southern Yemen and Ethiopia (Eritrea).

The ruandana-subgroup

Tongue of male genital capsule entire; pronotal disc with a pair of large, blunt tubercles sublaterally; membrane of hemelytron suffused with brown pigment.

Clavigralla ruandana (Schouteden) **comb. n.**

(Figs 137–143)

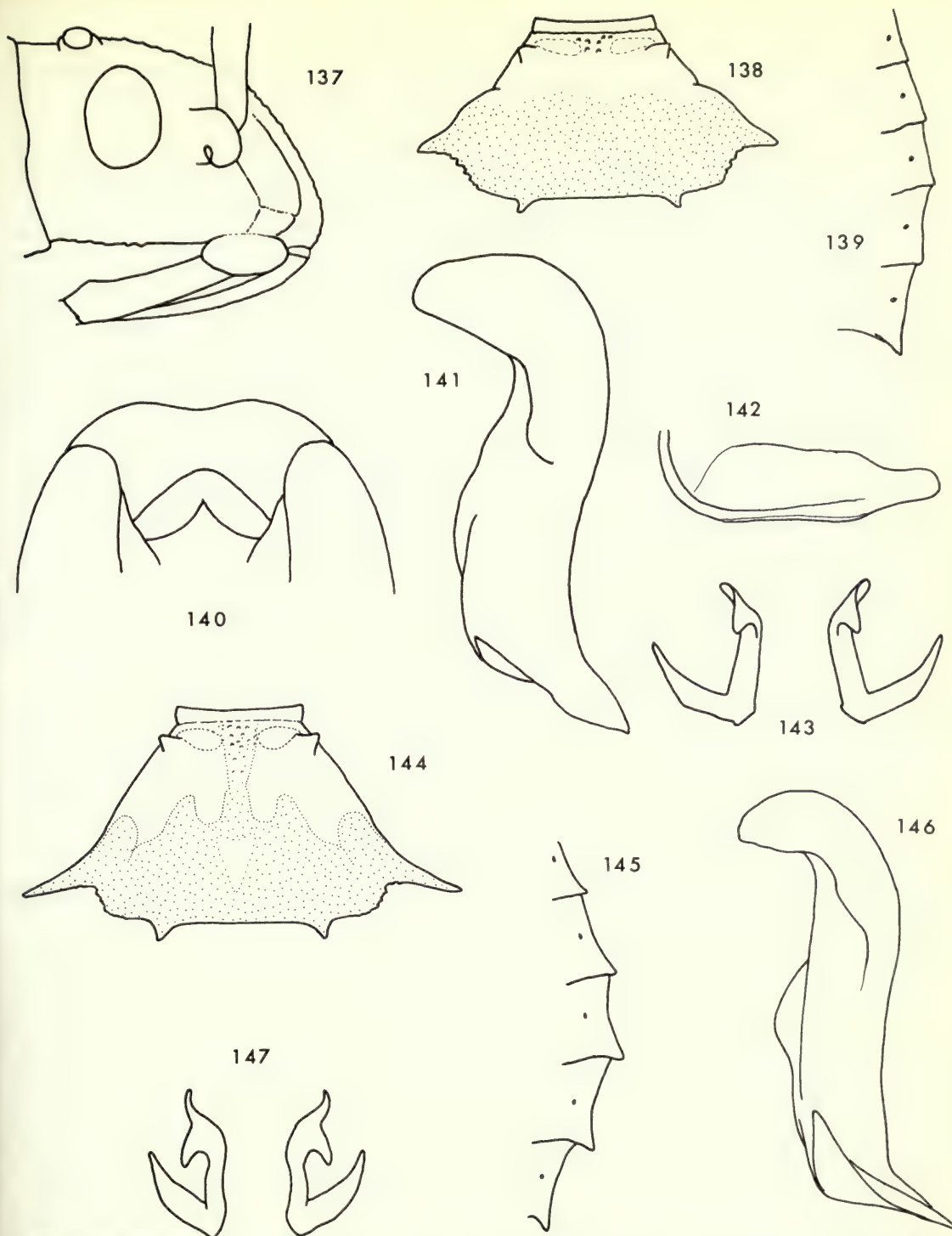
Acanthomia ruandana Schouteden, 1957: 309–310. LECTOTYPE ♂, RWANDA (MRAC, Tervuren), here designated [examined].

Length: ♂, 9.0–10.0 mm, mean 9.5 mm ($n = 8$); ♀, 9.3–10.6 mm, mean 9.9 mm ($n = 9$). Rather more slender than *C. tomentosicollis*, which it somewhat resembles.

Head (Fig. 137) elongate. Length of antennal segment I divided by width of head including eyes in male 0.87–1.11, mean 1.00 ($n = 8$), in female 0.80–1.10, mean 0.97 ($n = 9$). Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 1.05 : 0.73 : 1.12, in female about 1.00 : 1.07 : 0.75 : 1.06. Length of basal segment of rostrum divided by width of head including eyes in both sexes 0.81–1.01, mean 0.91 ($n = 17$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.94 : 0.59 : 0.90.

Pronotum (Fig. 138) with posterolateral spines short, directed slightly posteriorly. Width of pronotum across apices of posterolateral spines divided by width of head including eyes in male 2.48–3.06, mean 2.66 ($n = 8$), in female 2.31–2.79, mean 2.56 ($n = 9$). Scutellum strongly convex. Corium with apex produced, at rest reaching level of middle of laterotergite VI. Posterior tibia almost straight; length of posterior tibia divided by that of posterior femur 0.73–0.82, mean 0.77 ($n = 17$).

Abdominal sternites III–VI with posterolateral angles (Fig. 139) very slightly prominent, not acute, posterolateral angle of sternite VII acutely projecting in male, narrowly rounded in female. Male genital capsule (Fig. 140) with lip shallowly emarginate, tongue narrowly rounded. Paramere (Fig. 141) falcate, apex strongly curved medially, tooth at mid-point of blade small. Conjunctiva with dorsomedian lobe bearing large, finger-like, erect lobes at its posterolateral angles; intermediate dorsal, distal dorsomedian and distal dorsolateral lobes poorly developed; apical ventral and distal ventrolateral lobes well developed; ventral lobes very small; none of the lobes sclerotized. Second valvula of ovipositor (Fig. 142) slender,



Figs 137-147 *Clavigralla* species. (137) *ruandana* ♀, head, right lateral view; (138) same, lectotype ♂, pronotum, dorsal view; (139) same, left lateral margin of ♂ abdominal sternites III-VII, ventral view; (140) same, apical half of ♂ genital capsule, dorsal view; (141) same, left paramere, dorsal view; (142) same, second valvula, lateral view; (143) same, sclerites of dorsal wall of gynatrium, dorsal view; (144) *biston*, ♀ pronotum, dorsal view; (145) same, left lateral margin of ♀ abdominal sternites III-VII; (146) same, left paramere, dorsal view; (147) same, sclerites of dorsal wall of gynatrium, dorsal view.

apical third abruptly narrower than basal two-thirds; sclerites of dorsal wall of gynatrium (Fig. 143) with longitudinal arms abruptly divergent at apices and barbed; spermatheca similar to that of *C. tomentosicollis* except that bulb is distinctly narrower, duct slightly longer and sometimes with incipient convolutions.

Sculpture as in *C. tomentosicollis*. General coloration a slightly rufous brown, clavus and corium paler. Piceous markings variable, generally comprising a streak occupying ventral surface of antennal segment I, the whole ventral surface and often parts of sides of head, thoracic sterna, a horizontal bar on each of the thoracic pleura, a patch in anterior midline of pronotum, posterolateral spines and sublateral tubercles of disc of pronotum, base of scutellum, spots on femora, base of abdominal venter except midline and a broad, lateral, marginal band on abdominal sterna III–VI, sometimes III–VII, rarely only III–IV. Stramineous areas include tibiae except for basal, apical and usually median annuli, bases of femora and often antennal segments II and III. Membrane of hemelytron infusate with veins and basal cells colourless. Pubescence generally as in *C. tomentosicollis* but often with an incipient longitudinal band of pale hairs along midline of posterior lobe of pronotum and usually with a narrow band of dense, silvery or golden hairs along apical margin of corium and clavus contrasting strongly with the almost uniform colouring and pubescence of the remainder of these parts. Colour of abdominal dorsum varying from almost uniformly orange to largely piceous.

REMARKS. *C. ruandana* belongs to a group of species in which the head is elongate and the rostrum at rest reaches beyond the posterior margin of the mesosternum. Within this group it is distinguished by the basal antennal segment being subequal in length to the width of the head, the non-acute posterolateral angles of abdominal sterna III–VI, the absence of discrete spots on the forewing membrane and the moderately long posterolateral pronotal spines. A single female from Rhodesia is of a pale, golden-brown colour with few piceous markings. It is not possible to say if this difference is due to a difference in the genetic constitution of the populations in Rhodesia and elsewhere or if the specimen is merely teneral.

DISTRIBUTION. Highlands of central Africa, mostly around the Rift Valley.

MATERIAL EXAMINED

Acanthomia ruandana Schouteden, lectotype ♂, **Rwanda**: Contrefort Est Muhavura, 2100 m, 28.i.1953 (*P. Basilewsky*) (MRAC, Tervuren).

Rwanda: 1 ♂, same data as lectotype; 2 ♀, Contrefort Sud Nyamateke, 2200 m, 15.xi.1953 (*Basilewsky*), all paralectotypes of *Acanthomia ruandana* (MRAC, Tervuren). **Zaire**: 3 ♂, 2 ♀, Tshibinda [‘Tanganyika T., Tshibinda’ on labels], 21–27.viii.1931 (*Prof. T. D. A. Cockerell, Miss A. Mackie*) (BMNH, London); 1 ♂, 1 ♀, Kivu, Mulugu, Tshibinda, xi.1951 (*P. C. Lefèvre*) (MRAC, Tervuren); 3 ♀, Lualaba river, 750–1200 m, 31.v.1907 (*Neave*) (BMNH, London); 1 ♂, Malongi, vi.1943 (*H. J. Brédo*) (IRSNB, Brussels). **Zambia**: 1 ♂, 1 ♀, Chisinga Plateau, Kalungwisi District, 1400 m, 17.ix.1908 (*S. A. Neave*) (UM, Oxford). **Rhodesia**: 1 ♀, Mtarazi Falls, iii.1957 (*N. L. H. Krauss*) (BMNH, London).

Clavigralla biston sp. n.

(Figs 144–147)

Length: ♂, 9.3 mm ($n = 2$); ♀, 8.7–10.7 mm, mean 9.6 mm ($n = 7$). Resembles *C. ruandana* in most features and probably closely related to that species, differing chiefly in the more pronounced pronotal spines.

Head elongate. Length of antennal segment I divided by width of head including eyes in male 1.32–1.38 ($n = 2$), in female 1.35–1.43, mean 1.38 ($n = 7$). Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.85 : 0.68 : – (IV missing in both specimens seen), in female about 1.00 : 0.87 : 0.68 : 0.92. Length of basal segment of rostrum divided by width of head including eyes in both sexes 0.70–0.79, mean 0.74 ($n = 9$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.86 : 0.54 : 0.87.

Pronotum (Fig. 144) with posterolateral spines rather long, directed posterolaterally; width across apices of spines divided by width of head including eyes in male 2.58–2.72 ($n = 2$), in female 2.69–2.93, mean 2.79 ($n = 5$). Scutellum strongly convex. Corium with apex narrowly produced, at rest reaching to level of base of laterotergite VI. Posterior tibia gently curved at base, its length divided by that of posterior femur 0.73–0.79, mean 0.75 ($n = 8$).

Abdominal sternites with posterolateral angles triangularly produced (Fig. 145). Male genital capsule with lip broadly rounded, tongue rather narrow and parallel-sided for most of its length, apex rounded or

bluntly angulate. Paramere (Fig. 146) with apex strongly angled inwards, tooth at middle of blade moderately prominent. Aedeagus as described for *C. oxonis* (Fig. 152) except that all parts of ejaculatory reservoir complex are smaller and vesica is shorter, its non-coiled portion subequal in length to rest of aedeagus. Second valvula of ovipositor of similar general shape to that of *C. oxonis* (Fig. 153) but with apical lobe rather broader. Spermatheca as in *C. oxonis* (cf. Fig. 149). Sclerites of dorsal wall of gynatrium (Fig. 147) with recurved processes on median arms large. Coloration generally bright orange-brown (not red-brown as in its relatives), with darkest markings, on sides and ventral surface of head, thorax and abdomen, usually red-brown or brown (not piceous). Pronotum (Fig. 144) with midline of declivent area occupied by a band of brown pubescence terminating posteriorly in a tuft of erect, brown hairs flanked by two narrow projections of the area of silvery pubescence, these projections themselves each flanked on the outer side by a triangular area of erect, brown pubescence. Posterior lobe of pronotum behind this area with decumbent, golden-brown pubescence except for posterior margin and a more or less distinct, longitudinal, rectangular or triangular area in midline, where the decumbent pubescence is silvery. Scutellum with rather long, slightly tomentose pubescence and a pair of tufts of erect, brown hairs on disc. Clavus and most of corium pale orange-brown with short, crisped, semidecumbent, silvery to golden-brown pubescence, corium with a very distinct band close to apical margin brown, with short, suberect, brown pubescence, apical margin with a narrow band of silvery pubescence contrasting strongly with the broader, brown band. Produced apical part of corium pale rufous with short, silvery to golden, semidecumbent pubescence. Membrane infumate between the colourless longitudinal veins, the brown coloration slightly more intense in middle.

REMARKS. A distinctive species by reason of the shape of the pronotum and bright coloration.

DISTRIBUTION. Highlands in the vicinity of the Rift Valley.

MATERIAL EXAMINED

Holotype ♂, **Malawi:** Cholo, 1919–1920 (*R. C. Wood*) (BMNH, London).

Paratypes. **Malawi:** 1 ♂, 1 ♀, Cholo, 1919–1920 (*R. C. Wood*) (BMNH, London). **Zambia:** 1 ♂, 4 ♀, Mid Luangwa Valley, 600 m (2000 ft), 14–16.viii.1900 (*S. A. Neave*) (BMNH, London). **Tanzania:** 1 ♀, Lulangu, 27 km (17 miles) W. of Tabora, xi.1917, on bushes (*G. D. H. Carpenter*) (BMNH, London). **Rhodesia:** 1 ♀, Manica, Mpudzi River, c. 900 m (3000 ft), 26.x.1905 (*Guy Marshall*) (UM, Oxford).

Material excluded from type-series. **Angola:** 1 ♂, Caconda, Huile, 30.ix.1949 (*Borys Malkin*) (CAS, San Francisco). (Received after description was prepared.)

Clavigralla oxonis sp. n.

(Figs 148–153)

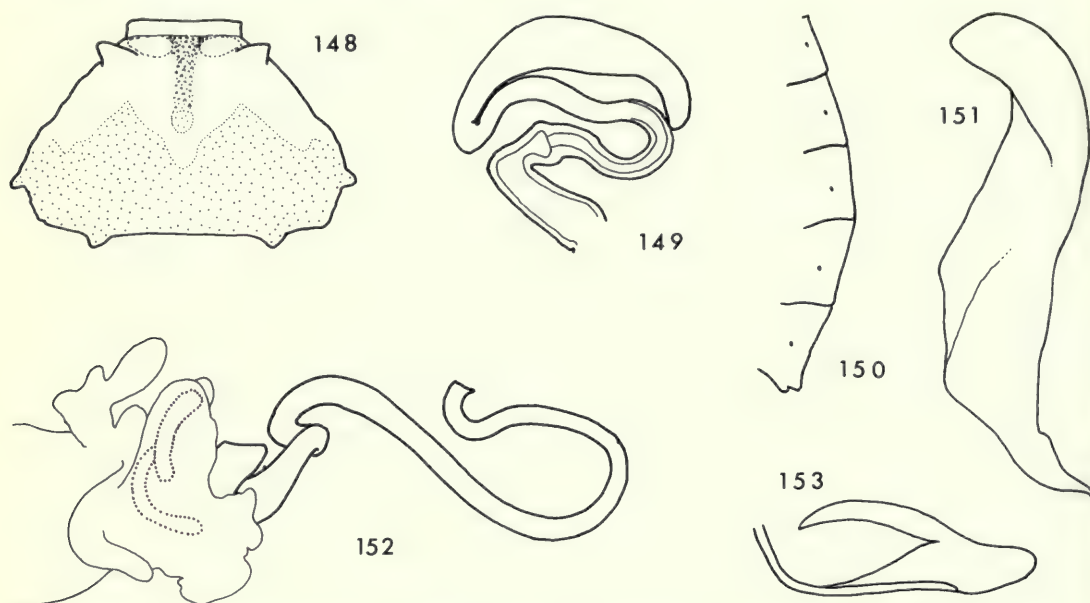
Length: ♂, 8.9 mm ($n = 1$); ♀, 9.0–9.1 mm ($n = 2$). Resembles *C. ruandana* in general build, but differs in many details including shape of pronotum.

Head elongate. Antennal segment I very short, its length divided by width of head including eyes in male 0.75 ($n = 1$), in female 0.79–0.84 ($n = 2$). Ratio of lengths of antennal segments I : II : III : IV in male unknown (specimen mutilated), in female about 1.00 : 1.13 : 0.84 : 1.33. Length of segment I of rostrum divided by width of head including eyes in both sexes 0.94–1.02, mean 0.99 ($n = 3$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.93 : 0.61 : 0.87.

Pronotum (Fig. 148) with posterolateral angles not prominent, posterolateral spines reduced to short tubercles or (male holotype) evanescent; width across apices of these posterolateral tubercles divided by width of head including eyes in male 2.15 ($n = 1$), in female 2.24–2.41 ($n = 2$). Scutellum strongly convex. Corium with apex at rest reaching to about level of suture between laterotergites V and VI. Posterior tibia gently arcuate in basal third, its length divided by that of posterior femur 0.68–0.73, mean 0.70 ($n = 3$).

Abdominal sternites III–VII with posterolateral angles rounded, not prominent except in segment VII of male (Fig. 150). Male genital capsule with lip evenly rounded, tongue narrowly rounded as in *C. ruandana* (cf. Fig. 140). Paramere (Fig. 151) falcate, tooth at middle of blade obsolete. Aedeagus (Fig. 152) with vesica very long, sclerites at its base and wings and straps of ejaculatory reservoir complex large, symmetrical. Conjunctiva with dorsomedian lobe large, bearing well-developed, sac-like outgrowths at its posterolateral angles, intermediate dorsal, distal dorsomedian and distal dorsolateral lobes weakly developed, apical, ventral and distal ventrolateral lobes well developed, ventral lobes absent. Second valvula of ovipositor (Fig. 153) slender. Sclerites of dorsal wall of gynatrium not differing from those of *C. ruandana*. Spermatheca (Fig. 149) with wide portion of duct rather long, narrow portion not convoluted, bulb narrow.

Pronotum, scutellum, thoracic pleura, apical half of each femur and apical one-third to half of corium reddish brown; ventral surface of head, base of scutellum, thoracic sterna, midline of declivent part of pronotum, base of abdominal venter medially and sometimes lateral stripes on head and thoracic pleura piceous; head, clavus, base of corium, antennal segments I and IV and abdominal sternites pale reddish brown; laterotergites obscurely patterned with pale and dark reddish brown; antennal segments II and III, tibiae, tarsi and bases of femora stramineous; forewing membrane brown, veins and basal cells colourless. Distribution of hair types as in *C. ruandana* and *C. tomentosicollis*; apical margin of corium with a narrow band of silvery hairs; junction between areas of pale and dark pubescence of pronotum (Fig. 148) strongly M-shaped, with a tuft of erect, brown hairs entirely surrounded by pale, tomentose hairs between the anterior corners of the 'M'.



Figs 148–153 *Clavigralla oxonis*. (148) pronotum, ♀ paratype, dorsal view; (149) spermatheca; (150) left lateral margins of abdominal sternites III–VII, ♂ holotype, ventral view; (151) left paramere of holotype, dorsal view; (152) conjunctiva and vesica of holotype, left lateral view; (153) second valvula of paratype, lateral view.

REMARKS. Distinguished from all other members of the genus by the very short pronotal posterolateral spines.

DISTRIBUTION. Known only from a small, hilly area of northern Zambia.

MATERIAL EXAMINED

Holotype ♂, **Zambia**: N. Lake Bangweolo, Luwingu, 4200 ft (1300 m), 9.vi.1908 (*S. A. Neave*) (UM, Oxford).

Paratypes. **Zambia**: 2 ♀, Abercorn, 15.xii.1943 and 4.iv.1944 (*H. J. Brédo*) (IRSNB, Brussels).

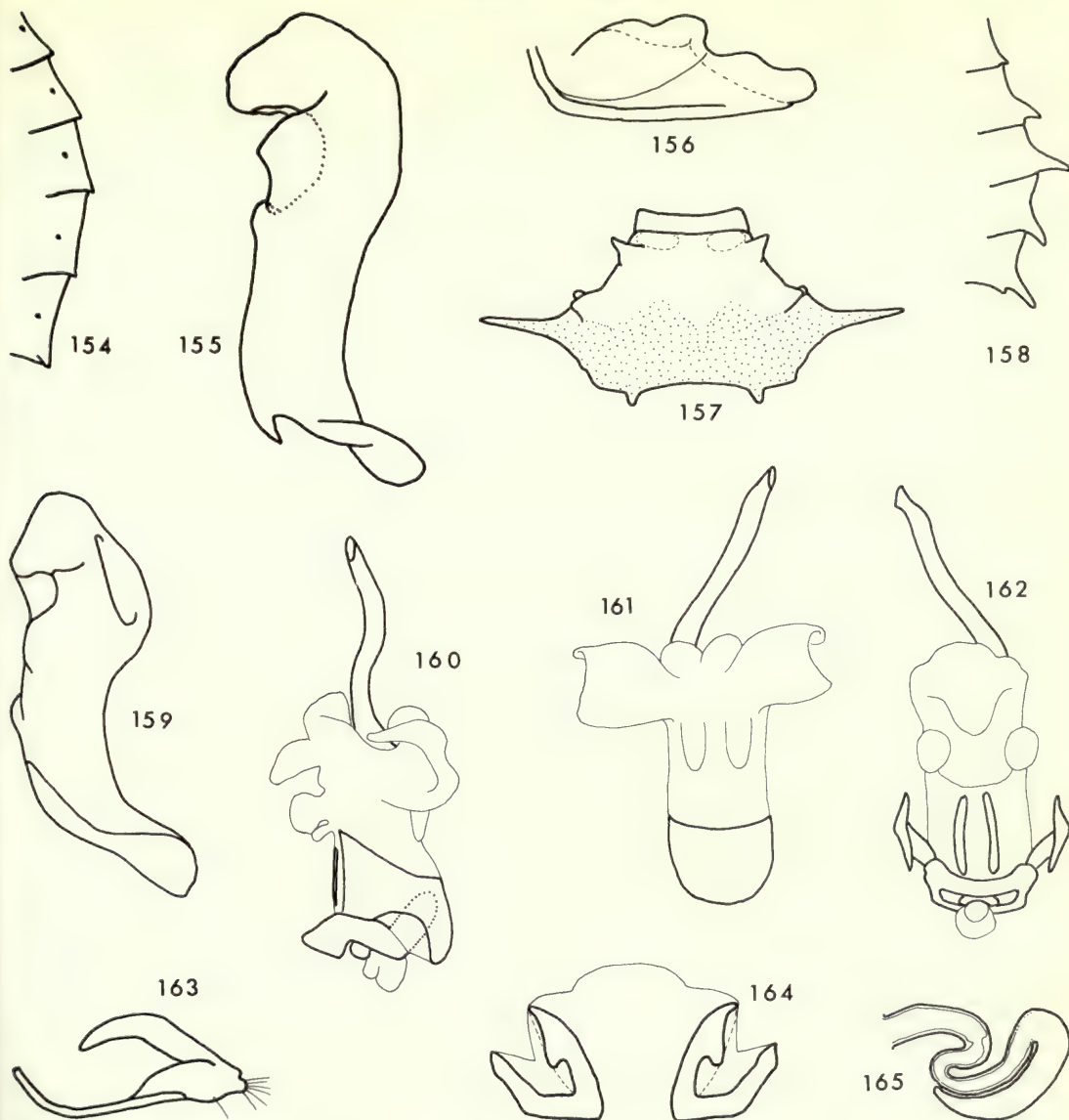
The *spiniscutis*-subgroup

Tongue of male genital capsule entire; pronotal disc with a pair of large, blunt, sublateral tubercles; membrane of hemelytron with a row of discrete, brown or piceous spots between bases of longitudinal veins, sometimes additionally blotched brown or piceous.

Clavigralla bovilla sp. n.

(Figs 154–156)

Length: ♂, 8.3 mm ($n = 1$); ♀, 8.4–8.8 mm, mean 8.6 mm ($n = 3$). Similar in build to *C. tomentosicollis*; resembles *C. ruandana* in the elongate head and posteriorly directed pronotal posterolateral spines.



Figs 154-165 *Clavigralla* species. (154) *bovilla*, left lateral margin of ♂ abdominal sternites III-VII, ventral view; (155) same, left paramere, dorsal view; (156) same, second valvula, lateral view; (157) *pusilla*, ♂ pronotum, dorsal view; (158) same, left lateral margin of ♂ abdominal sternites III-VII, ventral view; (159) same, left paramere, dorsal view; (160) same, aedeagus, left lateral view; (161) same, aedeagus, ventral view; (162) same, aedeagus, dorsal view; (163) same, second valvula, lateral view; (164) same, sclerites of dorsal wall of gynatrium, dorsal view; (165) same, spermatheca.

Length of antennal segment I divided by width of head including eyes in male 0.96 ($n = 1$), in female 0.90-0.94, mean 0.92 ($n = 3$). Ratio of lengths of antennal segments I : II : III : IV in male as 1.00 : 0.91 : 0.69 : 1.13, in female about 1.00 : 0.85 : 0.70 : 1.06. Length of basal segment of rostrum divided by width of head including eyes in both sexes 0.86-0.90, mean 0.88 ($n = 4$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.94 : 0.60 : 0.87.

Pronotum similar in shape to that of *C. ruandana* (cf. Fig. 138), with the posterolateral spines directed slightly posteriorly; width across apices of spines divided by width of head including eyes in both sexes

2.57–2.60, mean 2.59 ($n = 4$). Corium with apex slightly produced, at rest reaching to level of base of abdominal laterotergite VI. Posterior tibia with gentle curvature near base, its length divided by length of posterior femur 0.71–0.75, mean 0.73 ($n = 5$).

Abdominal sternites III–VII (Fig. 154) with posterolateral angles acute, slightly prominent. Male genital capsule with lip evenly rounded, not emarginate, tongue rounded as in *C. ruandana*. Paramere (Fig. 155) with blade broad, thick, apex bluntly hooked, tooth at middle of blade well developed. Conjunctiva could not be fully expanded in only specimen available. Female with sclerites of wall of gynatrium similar to those of *C. ruandana*; spermatheca like that of *C. tomentosicollis* but bulb narrower; second valvula of ovipositor (Fig. 156) unevenly narrowed towards apex.

Colour and pubescence generally as in *C. ruandana* but piceous markings absent from antennal segment I and absent or almost absent from sides of abdominal sternites; laterotergites marked with stramineous and rufous brown, not piceous; junction between pale and dark areas of pubescence on pronotum slightly undulating, with four evenly spaced tufts of pale hairs at junction, without any pale hairs in midline of posterior lobe, a tuft of slightly darker hairs present behind each large sublateral tubercle of disc, about equidistant from tubercle and from junction of pale and dark areas; no line of silvery or golden hairs present along apical margin of corium or clavus; membrane of hemelytron colourless with a row of piceous spots between longitudinal veins just distal to basal cells and parallel with apical margin of corium.

REMARKS. Differs from the other species with long heads (*ruandana*-subgroup) in the possession of discrete piceous spots in the forewing membrane, rather than an even suffusion of pigment. The shape of the second valvula and paramere are characteristic. During dissection of the abdomen of a female paratype a single, very small, hymenopterous larva was found in the haemocoel. It was presumably a first instar, being slender, tailed and provided with a broad head bearing large mandibles. It is possibly a euphorine braconid.

DISTRIBUTION. Known only from the type-locality in the hills of N. Zambia.

MATERIAL EXAMINED

Holotype ♂, **Zambia**: Abercorn, 15.xii.1943 (*H. J. Brédo*) (IRSNB, Brussels).

Paratypes. **Zambia**: 4 ♀, Abercorn, x.1943, xi.1943, 15.xii.1943, 4.iv.1944 (*Brédo*) (IRSNB, Brussels).

Clavigralla pusilla sp. n.

(Figs 157–165)

Length: ♂, 6.5–7.0 mm, mean 6.7 mm ($n = 7$); ♀, 6.7–7.3 mm, mean 7.0 mm ($n = 3$). A small, rather slender species.

Antennifers almost parallel, juga slightly tumid. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.82 : 0.72 : 0.98, in female about 1.00 : 0.88 : 0.75 : 0.95; length of segment I divided by width of head including eyes in male 1.28–1.41, mean 1.32 ($n = 7$), in female 1.22–1.26, mean 1.24 ($n = 3$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.94 : 0.52 : 0.84; length of segment I divided by width of head including eyes 0.57–0.64, mean 0.62 ($n = 5$).

Pronotum (Fig. 157) strongly declivent, centre of posterior lobe with a short, longitudinal ridge intersecting a similar transverse one; spines of posterolateral angles long, laterally directed, straight or gently upcurved; posterolateral angles just anterior to base of each spine with a pair of short, stout spines; paired, sublateral spines of disc very prominent; width across apices of posterolateral spines divided by width of head including eyes in male 2.50–3.07, mean 2.77 ($n = 4$), in female 2.40–2.73, mean 2.57 ($n = 3$). Scutellum convex, midline slightly depressed, apex slightly produced. Corium narrow, its apex slightly produced, at rest reaching suture between abdominal laterotergites V and VI. Posterior tibia gently curved near base, its length divided by length of posterior femur 0.65–0.70, mean 0.68 ($n = 5$).

Abdominal sternites III–VII with posterolateral angles produced into strong spines (Fig. 158). Male genital capsule with lip rounded, tongue entire and narrowly triangular. Paramere (Fig. 159) stout, with shallow depression on dorsolateral face, tooth at middle of blade projecting dorsally. Conjunctiva (Figs 160–162) with all lobes membranous, dorsomedian lobe low, its lateral angles projecting almost independently as small globular lobes slightly distal to main, transverse part of lobe; intermediate dorsal lobe large, conical, overhanging dorsomedian lobe; distal dorsomedian lobe poorly developed; distal dorsolateral lobes obsolete; apical ventral, distal ventrolateral and ventral lobes well developed; vesica large in comparison with size of conjunctiva. Female with second valvula (Fig. 163) bearing a short, apical process; sclerites of dorsal wall of gynatrium (Fig. 164) with short 'barb' on longitudinal arms; spermatheca (Fig. 165) with bulb short, duct short and simply looped.

Head, legs and antennae obsoletely granulate, granulation more distinct on apices of femora and tibiae, pronotum anteriorly granulate, posteriorly punctate, pleura punctate-granulate, thoracic sterna and abdominal sterna and laterotergites minutely rough, clavus with three rows of punctures, corium in basal half with a few granules on veins and a few punctures between veins, apically unsculptured. Head and antennae with short, suberect, colourless pubescence, head and antennal segment I also with short, decumbent, silvery pubescence; pronotum anteriorly, on disc and along lateral and posterolateral margins with sparse, moderately long, erect, white pubescence, collar and declivent area also with rather dense, white, tomentose pubescence, posterior lobe with moderately long, decumbent, silvery hairs mixed with dense, suberect to decumbent, brown hairs, a small tuft of brown hairs present at middle of junction between areas of dark and pale pubescence; scutellum with long, dense, tomentose to suberect, silvery hairs, tinged more or less heavily with brown on disc; thoracic pleura and sterna with rather dense, white, decumbent, somewhat tomentose pubescence, pleura also with long, suberect, white pubescence; legs with rather short, suberect, white pubescence, femora also with short, semidecumbent to decumbent, white pubescence; clavus and corium with short, crisped, semidecumbent to decumbent, white pubescence; abdominal sterna with dense, decumbent to slightly tomentose, white pubescence, interspersed with long, erect, colourless hairs; laterotergites with white, decumbent pubescence. Colour generally as in *C. tomentosicollis* but antennae pale to mid-brown throughout and membrane colourless except for a row of piceous spots between bases of longitudinal veins parallel to apical margin of corium and piceous marks on two veins where they enter membrane from corium.

Ovarian egg (4 ex. seen) ovate, flattened dorsally, with chorion minutely reticulate; aeromicropyles separated into two groups as follows: 2 contiguous ones ventral to eclosion suture and 3 or 4 contiguous in a transverse row dorsal to the suture.

REMARKS. Differs from the only other Malagasy species of the *tomentosicollis*-group in the characters of the pigmentation of the membrane and the shape of the tongue of the male genital capsule, as well as the smaller size, more slender build and less strongly curved posterior tibia. Superficially similar to the African species *C. strabo* and *C. pabo* but body more slender and paramere stouter.

DISTRIBUTION. Southern Madagascar.

MATERIAL EXAMINED

Holotype ♂, **Madagascar**: Tulear Province, Betioky, 275 m, 15.iii.1968 (*K. M. G. & P. D.*) (BMNH, London).

Paratypes. **Madagascar**: 2 ♂, 2 ♀, same data as holotype (BMNH, London); 1 ♂, Région Sud de l'Ile, Bekily, vi.1936 (*A. Seyrig*); 1 ♂, Région du Sud, Andrahomana, vii.1901 (*Ch Alluaud*); 1 ♂, Région du Sud, Androy, between Antanimora and Ifotaka, xi.1901 (*Alluaud*); 1 ♂, Région du Sud, Androy, Ambovombé, xi.1901 (*Alluaud*); 1 ♀, Belumbe, 1900 (*Fairmaire*) (MNHN, Paris).

Clavigralla strabo sp. n.

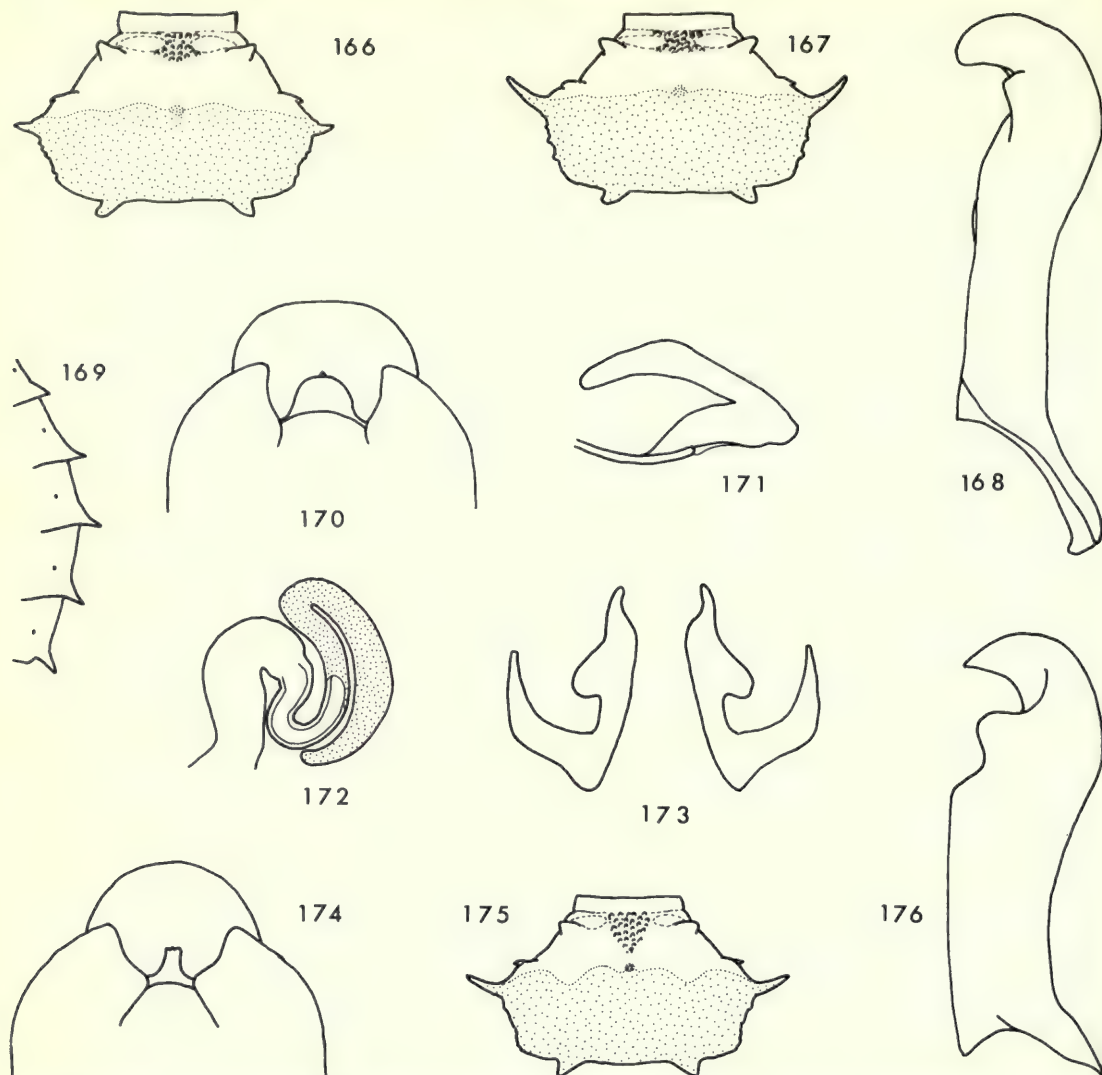
(Figs 166–173)

Length: ♂, 7.0–7.3 mm, mean 7.1 mm ($n = 3$); ♀, 6.6–8.3 mm, mean 7.7 mm ($n = 9$). Similar in size and build to *C. spiniscutis*.

Head short, antennifers slightly divergent. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.77 : 0.65 : 0.89, in female about 1.00 : 0.81 : 0.69 : 0.87. Antennal segment I moderately robust and bearing long, erect hairs, length of segment divided by width of head including eyes in male 1.06–1.23, mean 1.14 ($n = 3$), in female 1.05–1.15, mean 1.09 ($n = 9$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.89 : 0.62 : 0.92; length of basal segment divided by width of head including eyes 0.56–0.66, mean 0.59 ($n = 10$).

Pronotum (Figs 166, 167) with posterolateral angles moderately prominent, usually with a distinct spine or tubercle laterally on anterior part of each prominence; posterolateral spines slender, gently up-curved and also curved slightly anteriorly, variable in length (extreme variants figured in Figs 166, 167); width across apices of posterolateral spines divided by width of head including eyes in male 2.19–2.27, mean 2.22 ($n = 3$), in female 2.13–2.50, mean 2.27 ($n = 7$). Corium with apex not produced, at rest with apex reaching posteriorly to level of apical one-third of laterotergite V, rarely as far as suture between laterotergites V and VI. Posterior tibia straight, its length divided by length of posterior femur 0.65–0.70, mean 0.68 ($n = 11$).

Abdomen with posterolateral angles of sternites III–VII produced into rather stout but very acute spines (Fig. 169); tergum IX of female slightly deflexed apically. Male genital capsule (Fig. 170) with lip broad,



Figs 166-176 *Clavigralla* species. (166) *strabo*, ♂ pronotum, dorsal view, from Rustenburg; (167) same, ♂ pronotum, dorsal view, Louis Trichardt; (168) same, left paramere, dorsal view; (169) same, left lateral margin of abdominal sternites III-VII, ventral view; (170) same, apical half of ♂ genital capsule, dorsal view; (171) same, second valvula, lateral view; (172) same, spermatheca; (173) same, sclerites of dorsal wall of gynatrium, dorsal view; (174) *pabo*, apical half of ♂ genital capsule, dorsal view; (175) same, ♂ pronotum, dorsal view; (176) same, left paramere, dorsal view.

prominent, slightly truncate, tongue rounded. Paramere (Fig. 168) with apex strongly incurved, blunt, tooth at middle of blade prominent, well developed. Ejaculatory reservoir complex with wings, straps and vesica moderately long. Conjunctiva entirely membranous; dorsomedian lobe low, with a pair of short, finger-like lobes arising from its base posterolaterally; intermediate dorsal lobe large, higher than finger-like lobes; distal dorsomedian and distal dorsolateral lobes small; apical ventral and distal ventrolateral lobes normally developed; small, paired, ventral lobes present. Female with apex of second valvula of ovipositor (Fig. 171) broadly prominent; spermatheca (Fig. 172) with bulb narrow, duct about three times as long as bulb, not convoluted, with broad and narrow regions about equal in length; sclerites of dorsal wall of gynatrium (Fig. 173) with broad expansions on median arms.

Head, thoracic pleura and sterna, declivent part of pronotum, scutellum and abdominal sterna with rather dense, decumbent, silvery white, tomentose pubescence; head dorsally also with very long, sparse,

erect pubescence, laterally and ventrally with shorter, suberect pubescence. Antennal segment I bearing short, rather sparse, decumbent, silvery pubescence and long, erect, colourless hairs much longer than diameter of segment; segments II and III with rather long, suberect hairs the longest of which are longer than width of segments; pubescence of rostrum mainly consisting of rather short, suberect hairs and, on segments I and II, some decumbent, silvery hairs; propleura and declivent part of pronotum also with long, erect hairs in addition to the tomentose indumentum; horizontal part of pronotum with golden-brown to dark brown, decumbent to erect pubescence, mostly of short to moderately long hairs, in the posterior part mostly decumbent with a few pale brown, erect hairs intermixed; centre of junction between anterior, pale and posterior, dark areas of pronotal pubescence with a small brush of erect, brown hairs; disc and sides of scutellum with long pubescence, white except for anterior part of disc where hairs are brown; thoracic and abdominal sterna also with moderately long, suberect, silvery hairs; clavus and corium with short, crisped, silvery to golden pubescence with an admixture of short, slightly tomentose hairs of the same colour along costal margin of corium and apical margins of clavus and corium; abdominal laterotergites with a mixture of these two types of pubescence; legs with long, erect, colourless to pale brown hairs much longer than width of tibiae and shorter, suberect hairs, femora also with decumbent, silvery hairs. Head, thoracic pleura and abdominal sterna pale brown with obscure, darker brown to piceous markings; thoracic sterna piceous; pronotum pale brown anteriorly, chestnut-brown in posterior, horizontal part, tubercles in anterior midline piceous, this group of tubercles extending laterally to embrace calli for one-third to one-half of their width but not extending posteriorly beyond level of the large, sublateral tubercles, sublateral tubercles and posterolateral spines of pronotum piceous; scutellum pale brown, broadly piceous at base; clavus and corium stramineous, veins anteriorly with some granules piceous, apical one-third of corium heavily marked with dark or reddish brown mottling; membrane milky-hyaline, bases of two veins at junction with corium and 1-5 discrete spots between longitudinal veins close to basal cells dark brown or piceous; femora pale yellowish brown in basal one-quarter to one-third, otherwise dark reddish brown with a few paler spots, pale area at base of femur sometimes with extensive darker markings; tibiae and tarsi yellowish brown to stramineous, tibiae with basal and apical annuli reddish brown; antennae pale yellowish brown, apices of segments I-III and whole of IV sometimes infusate; spines at posterolateral angles of abdominal sternites piceous; abdominal laterotergites dark brown, III-V each with a narrow, transverse band near anterior margin stramineous, VI with a broader stramineous band in the same position, lateral exposed areas of tergite VII coloured as laterotergites VI.

Ovarian egg with granular, polygonal sculpture on chorion and with 3-4 aeromicropyles close together in a straight line on rim where flat, dorsal and convex, ventral sides of egg meet.

REMARKS. This species closely resembles *C. spiniscutis* in general appearance but differs from it in the pubescence of the scutellum, which is not organized into spine-like tufts, the coloration of the hemelytral membrane which never has irregular piceous patches but only a few discrete spots, the straight posterior femur, the much stronger dorsal tooth of the paramere and other details of the male genitalia.

DISTRIBUTION. All specimens seen were taken at medium altitudes in southern Africa between latitudes 17° S and 30° S.

MATERIAL EXAMINED

Holotype ♂, **Botswana:** 1 ♂, Bakgatla, Sebele, in grass, 8.viii.1968 (*R. E. Roome*) (BMNH, London).

Paratypes. **Botswana:** 1 ♀, Ghanzi, 13.ix.1926 (*J. Maurice*) (BMNH, London); 1 ♀, Samengeigeei, Kaukau Kungv., vi.1951 (*C. Koch*) (TM, Pretoria). **Rhodesia:** 1 ♀, Sawmills, 1.iv.1923 (BMNH, London). **South West Africa:** 1 ♀, Abachaus, Otjiwarongo District, iii.1950 (*G. Hobohm*); 1 ♀, Ovamboland, Oshikango, vii.1948 (TM, Pretoria). **South Africa:** 1 ♂, 1 ♀, Rustenburg, xii.1961 (*A. L. Capener*); 1 ♂, 1 ♀, Louis Trichardt, 6.ii.1941 (*Capener*) (TM, Pretoria); 1 ♀, Natal, Durban (*J. P. Cregoe*); 1 ♀, Transvaal, Zoutpansberg (*H. Junod*) (BMNH, London).

Clavigralla pabo sp. n.

(Figs 174-176)

Length: ♂, 6.4-7.1 mm, mean 6.7 mm ($n = 3$). Female unknown. Very similar to *C. strabo* and *C. spiniscutis* in general appearance.

Head short, antennifers distinctly divergent, especially at the base. Ratio of lengths of antennal segments I : II : III : IV about 1.00 : 0.82 : 0.70 : 0.97; segment I slender, bearing short, suberect hairs much shorter than diameter of segment; length of segment I divided by width of head including eyes 1.17-1.22, mean 1.20 ($n = 3$). Ratio of lengths of rostral segments I : II : III : IV as 1.00 : 0.93 : 0.53 : 0.87 and

length of basal segment divided by width of head including eyes 0.60 in only specimen (from Natal) where rostrum is visible.

Pronotum (Fig. 175) with posterolateral spines long and slender, width across apices of spines divided by width of head including eyes 2.19–2.37 ($n = 2$, both from Mozambique). Posterior tibia distinctly arcuate basally, its length divided by length of posterior femur 0.70–0.72, mean 0.71 ($n = 3$).

Genital capsule (Fig. 174) with lip prominent, broadly rounded, tongue very narrow. Paramere (Fig. 176) with tooth at middle of blade very large, apex of blade strongly incurved, acutely pointed. Aedeagus as in *C. strabo*.

Coloration and distribution of pubescence as in *C. strabo* except that the length of the hairs, particularly the outstanding hairs of the appendages, is much less; longest hairs on antennal segments I–III suberect, shorter than diameter of segment II; longest hairs on legs suberect to erect, shorter than or just equal to diameter of tibiae. Hemelytral membrane with rather extensive pale brown markings in addition to a row of piceous spots between veins close to basal cells. Group of piceous tubercles in anterior midline of pronotum extending posteriorly well behind level of sublateral tubercles, not deeply embracing calli.

REMARKS. The unique shape of the tongue of the genital capsule distinguishes this species from all its relatives. Superficially it might be confused with *C. strabo*, from which it differs in the much shorter pubescence of the appendages and the shape of the patch of piceous granules in the anterior midline of the pronotum, or with *C. spiniscutis* from which it differs in the much paler pigmented patches of the hemelytral membrane and in lacking the specialized arrangement of pubescence on the scutellum of that species.

DISTRIBUTION. Known only from the Delagoa Bay – Lake St Lucia area on the eastern coast of southern Africa.

MATERIAL EXAMINED

Holotype ♂, **Mozambique**: I. de Inhaca, 20–22.ii.1971 (*F. Simoes*) (Duarte coll.).

Paratypes. **Mozambique**: 1 ♂, I. de Inhaca, 27–30.iii.1971 (*F. Madureira*) (Duarte coll.). **South Africa**: 1 ♂, Natal, Lake St Lucia, Charters Creek, 12.xi.1967 (*J. A. & S. Slater, T. Schuh*) (Slater coll.).

Clavigralla spiniscutis (Bergróth) **comb. n.**

(Figs 177–184)

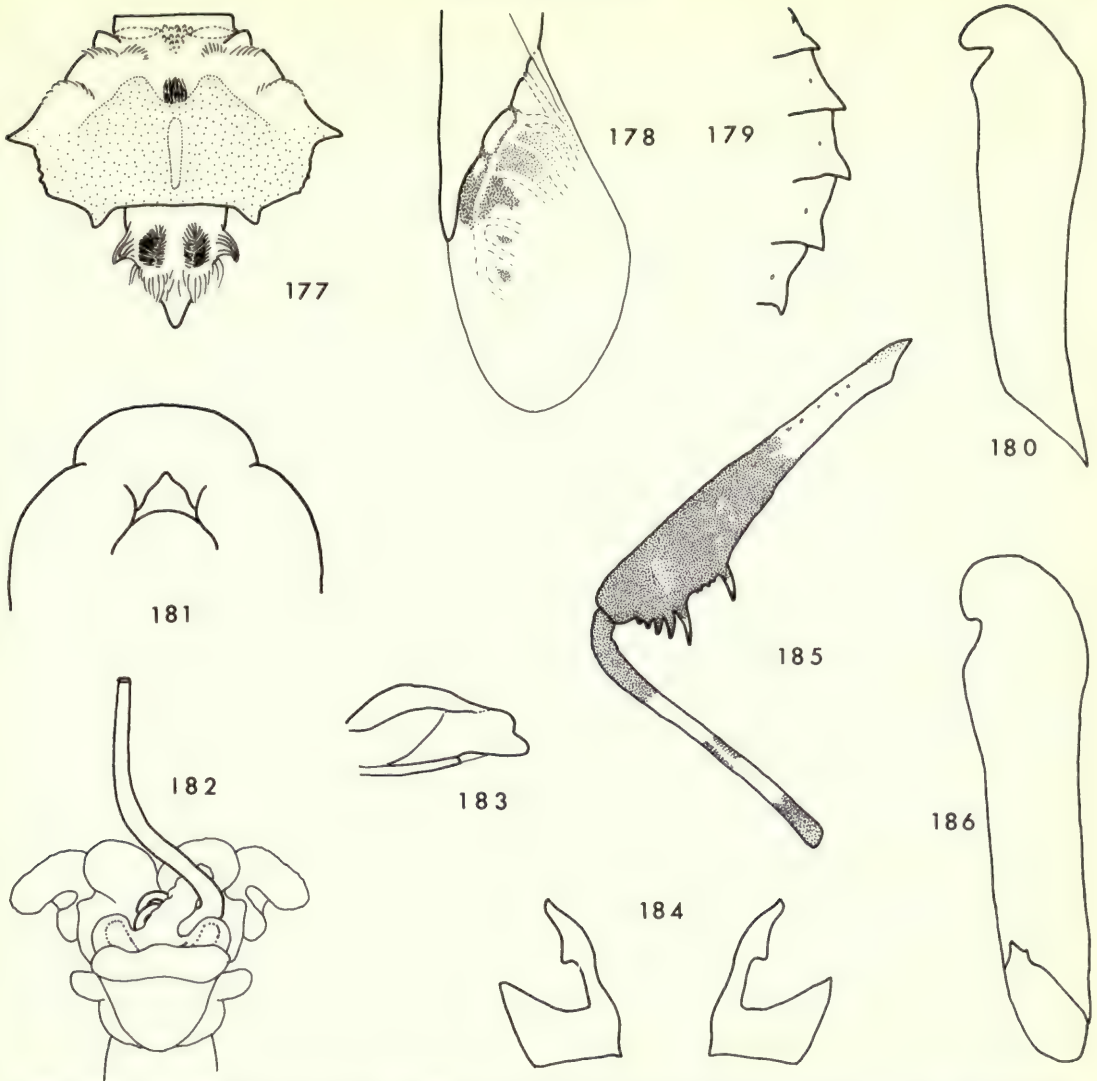
Acanthomia spiniscutis Bergróth, 1913 : 328–329. Type ♂, CENTRAL AFRICAN REPUBLIC [not seen; perhaps present but unrecognized at ZMU, Helsinki].

Length: ♂, 6.9–7.8 mm, mean 7.3 mm ($n = 10$); ♀, 6.8–8.4 mm, mean 7.6 mm ($n = 7$). A small, generally dark coloured species of rather stout build.

Head short, antennifers very slightly divergent. Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.81 : 0.76 : 0.99, in female about 1.00 : 0.79 : 0.69 : 0.92. Antennal segment I rather stout, gradually and uniformly expanding towards apex, its length divided by width of head including eyes in male 0.96–1.15, mean 1.04 ($n = 9$), in female 0.96–1.16, mean 1.05 ($n = 7$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.86 : 0.58 : 0.90; length of segment I divided by width of head including eyes 0.56–0.71, mean 0.61 ($n = 17$).

Pronotum (Fig. 177) strongly declivent anteriorly, posterolateral angles strongly inflated but not produced laterally, posterolateral spines short, triangular; width of pronotum across apices of spines divided by width of head including eyes in male 2.11–2.41, mean 2.28 ($n = 9$), in female 2.13–2.40, mean 2.22 ($n = 7$). Scutellum convex, with a pair of callosities on disc, its shape usually obscured by dense tufts of pubescence (Fig. 177). Corium with apex weakly produced, at rest reaching posteriorly to level of suture between laterotergites V and VI. Posterior femur with the 2 major subapical spines almost equal in length, with 4–5 minor spines between them and a terminal series of four spines; posterior tibia short, strongly arcuate at base, its length divided by that of posterior femur 0.63–0.70, mean 0.66 ($n = 16$).

Abdominal sterna III–VII with posterolateral angles (Fig. 179) abruptly prominent as short, triangular teeth. Male genital capsule (Fig. 181) short, lip strongly and broadly projecting, tongue mucronate. Paramere (Fig. 180) strongly expanded towards apex, especially in vertical plane, tooth at middle of dorsal surface of blade very broad, apex of blade narrowly hooked but not acute. Conjunctiva (Fig. 182) rather similar to that of *C. curvipes*, with dorsomedian lobe broad and bearing small subsidiary lobes at its posterolateral basal angles; intermediate dorsal lobe large, conical; distal dorsomedian and distal dorsolateral lobes poorly developed but distinct, a finger-like median lobe arising from posterior face of conjunctiva above base of vesica; apical ventral lobes large, less rough on surface than those of *C.*



Figs 177–186 *Clavigralla* species. (177) *spiniscutis*, pronotum and scutellum, ♀, dorsal view; (178) same, ♀ left hemelytral membrane and apex of corium, dorsal view; (179) same, left lateral margin of ♀ abdominal sternites III–VII, ventral view; (180) same, left paramere, dorsal view; (181) same, apical half of ♂ genital capsule, dorsal view; (182) same, conjunctiva and vesica, dorsal view; (183) same, second valvula, lateral view; (184) same, sclerites of dorsal wall of gynatrium, dorsal view; (185) *marmorata* holotype ♂, right posterior femur and tibia, anterior view; (186) same, left paramere of holotype, dorsal view.

curvipes; distal ventrolateral lobes large; ventral lobes absent. Female with second valvula of ovipositor (Fig. 183) narrowly produced at apex. Spermatheca as in *C. curvipes*. Sclerites of dorsal wall of gynatrium (Fig. 184) with anterior arms very broad in the oblique transverse/frontal plane, median longitudinal arms each with a small external tooth.

Pubescence of antennae of short, suberect, pale hairs shorter than width of segment II, segment I also with short, decumbent, silvery hairs. Head with white, decumbent pubescence, dorsally very dense and obscuring ground colour, also with colourless, suberect, short hairs throughout and with long, erect, colourless hairs along dorsal midline; rostrum with short, suberect, colourless hairs and segments I and II also with short, decumbent, silvery hairs. Thoracic sterna and pleura and abdominal sterna with moderately long, tomentose, white pubescence interspersed with long or medium length, suberect, colourless

hairs; declivent area of pronotum (Fig. 177) with dense, tomentose, decumbent, white pubescence interspersed with long, sparse, erect, usually brown hairs; a short, transverse ridge of pale, tomentose pubescence present posterior to each sublateral tubercle of disc; posterior horizontal lobe with decumbent, golden-brown pubescence; junction between the two areas of pronotal pubescence marked by a median tuft of moderately long, dark brown hairs flanked by two triangular patches of short, erect, dark brown hairs, median tuft largely or entirely surrounded by white, tomentose pubescence which continues in a band along midline of pronotum posterior to tuft. Scutellum (Fig. 177) in fresh, unabraded specimens with two tufts of dark brown hairs on disc, flanked by long, white hairs which are organized into two thorn-shaped lateral brushes and an irregularly rounded or bifid posterior fringe. Clavus, corium and abdominal laterotergites with short, crisped to semidecumbent, silvery and golden-brown pubescence. Legs with suberect to erect, colourless pubescence the longest hairs of which are about as long as diameter of tibiae; femora also with decumbent, silvery hairs.

Head pale brown, ventral surface and some lateral markings and ocellar tubercles piceous. Antennae stramineous, segment I with external basal streak and broad, apical annulus brown, segments II and III each usually with an apical or subapical annulus brown, segment IV pale brown. Rostrum brown, segment IV largely piceous. Thorax and abdomen mainly brown, thoracic sterna, larger granules of thoracic pleura, median and lateral markings on abdominal sterna, pronotal midline and sublateral tubercles, pronotal posterolateral spines, integument beneath the 3 patches of erect, brown hairs on pronotum and base of scutellum piceous. Abdominal laterotergites III–V red-brown, VI and corresponding area of tergum VII stramineous with narrow basal and apical bands red-brown. Femora basally stramineous, apically confusedly mottled piceous and various shades of brown; tibiae stramineous with basal, apical and medial annuli brown; tarsi pale brown. Hemelytra with clavus and corium stramineous to pale brown, punctures pale brown, corium anteriorly with some large granules on basal parts of major veins piceous, apical one-third of corium confusedly mottled piceous and various shades of brown; membrane (Fig. 178) largely colourless with more or less discrete piceous markings basally which vary in extent, but always with some distinct spots between longitudinal veins near basal cells.

REMARKS. The small size and arcuate posterior tibiae could lead to confusion of this species with *C. curvipes*, from which it may always be distinguished by the presence of distinct, piceous markings on the hemelytral membrane which in *C. curvipes* is evenly suffused pale fuscous. The shape of the pronotum and the pattern of pubescence on the scutellum also serve to distinguish the two species. Examination of the form of the tongue of the genital capsule will confirm the identity of male specimens. Specimens from eastern and southern Africa differ from those from West Africa in having a slightly narrower head and slightly longer tibiae. In West African specimens the means of pronotum width, first antennal segment length and first rostral segment length divided by head width were found to be 2.24, 1.01 and 0.58 respectively, compared with values for eastern and southern specimens of 2.26, 1.09 and 0.64. The mean value of posterior tibia length divided by posterior femur length was 0.66 for West African specimens and 0.68 for eastern and southern specimens.

In his original description of this species, Bergróth (1913 : 328–329) apparently mistook the tufts or brushes of hairs on the scutellum for solid spines. This cannot be verified as the type-specimen cannot be located at present. According to Grant & Štys (1970 : 113) many of Bergróth's types have been recognized among the general collection of the ZMU, Helsinki, so it is possible that type-material of *spiniscutis* may one day come to light. For this reason and because the species is readily recognizable from the original description it seems inappropriate to designate a neotype.

DISTRIBUTION. A crescent-shaped area connecting Senegal, Kenya, Malawi, Botswana and Angola. No specimens attributable to this species were found in the extensive collections of Hemiptera from Zaire held by the IRSNB, Brussels and the MRAC, Tervuren.

MATERIAL EXAMINED

Senegal: 1 ♂, Niore, 12.x.1943, on rice (*Oryza sativa*) (*J. Risbec*) (BMNH, London). **Ivory Coast:** 1 ♂, Lamto, 11.xi.1965 (*Mme D. Gillon*) (BMNH, London). **Ghana:** 1 ♂, Tafo, 8.i.1967 (*R. Kumar*); 1 ♂, 2 ♀, Kpandu, 2.xi.1967 (*Kumar*) (UG, Legon). **Nigeria:** 2 ♂, 1 ♀, Samaru, 8.ix.1954, 12.i.1955, 12.ii.1956, at grass roots and on cotton (*Gossypium*) (*M. G. Emsley*) (BMNH, London). **Kenya:** 1 ♂, Migori Valley, S. Kavirondo, 1300 m, 2–4.v.1911 (*S. A. Neave*); 1 ♂, 1 ♀, Kisumu, 1145 m, xi.1920 (*A. F. J. Gedye*); 1 ♀, Nairobi, iv.1936 (*Gedye*); 1 ♀, N.F.D., Wajir, 25.i.1955 (*I. Lansbury*) (BMNH, London). **Tanzania:** 1 ♂,

Meru, vii.1943 (*Van Someren*); 2 ♂, no detailed data (*W. H. Potts*) (BMNH, London). **Malawi:** 1 ♀, Mlanje, 5.ix.1913, 700 m (*S. A. Neave*) (BMNH, London). **Angola:** 1 ♀, Luimbale, Mt Moco, 1800–1900 m, iii.1934 (*K. Jordan*) (BMNH, London). **Botswana:** 1 ♂, Moremi Reserve, 19° 23' S, 23° 33' E, 19.iv.1972 (*BMNH Southern Africa Expedition*) (BMNH, London).

Clavigralla marmorata sp. n.

(Figs 185, 186)

Length: ♂, 7.0–7.7 mm ($n = 2$). Female unknown. Resembles *C. spiniscutis* in colour and pubescence but of a much more slender build, with longer appendages and non-arcuate posterior tibiae. The paratype lacks antennal segments III and IV.

Head rather short, antennifers slightly divergent; antennae with segment I very slightly thickened in its apical one-third, its length divided by width of head including eyes 1.34 in both specimens. Ratio of lengths of antennal segments I : II : III : IV as 1.00 : 0.87 or 0.83 : 0.78 : 0.98; segment III slightly longer than width of head, other segments distinctly longer. Rostrum at rest reaching to disc of metasternum, ratio of lengths of segments I : II : III : IV about 1.00 : 0.93 : 0.53 : 0.83; length of basal segment divided by width of head including eyes 0.64–0.69.

Pronotum rather similar to that of *C. spiniscutis* but posterior, horizontal lobe behind posterolateral angles much shorter; width across apices of posterolateral spines divided by width of head including eyes 2.13–2.23. Apex of corium at rest reaching to level of base of abdominal laterotergite VI. Posterior tibia (Fig. 185) almost straight, its length divided by that of posterior femur 0.76–0.77.

Abdominal sternites III–VII with posterolateral angles projecting as broad, rather short spines. Male genital capsule with lip rounded, prominent, tongue triangular. Paramere (Fig. 186) moderately broad, apex curved towards midline of body, very blunt. Conjunctiva as in *C. spiniscutis* except for the presence of a pair of small ventrolateral lobes at about the level of the dorsomedian lobe; finger-like lobe on posterior face of conjunctiva above base of vesica much stouter at its base than that of *C. spiniscutis*.

Colour and distribution of pubescence as in *C. spiniscutis* but pubescence everywhere sparser; pubescence of antennae very short; pattern of hairs on pronotum exactly as in *C. spiniscutis* and that of scutellum very similar but less compactly concentrated into tufts; colour pattern of hemelytral membrane as in *C. spiniscutis*; abdominal laterotergites III–V dark brown with narrow, pale brown, transverse band close to anterior border of each, VI with a much broader band occupying basal half except for very narrow dark brown anterior margin, corresponding area of tergite VII pale brown except for narrow, dark brown bands at anterior and posterior margins.

REMARKS. The small size, dark coloration, non-arcuate posterior tibiae and particularly the very long antennae distinguish this species from its relatives. The shape of the paramere indicates a close relationship with *C. spiniscutis*.

DISTRIBUTION. Known only from Rhodesia and Transvaal.

MATERIAL EXAMINED

Holotype ♂, **South Africa:** Transvaal, Wylies Poort, 3–8.ii.1941 (*A. L. Capener*) (TM, Pretoria).

Paratype. **Rhodesia:** 1 ♂, Salisbury, 1898 (BMNH, London).

The tomentosicollis-subgroup

Tongue of male genital capsule trifid; pronotal disc with a pair of large, blunt, sublateral tubercles; membrane of hemelytron suffused fairly evenly with brown pigment, only rarely with some indication of spotting between the veins close to the basal cells.

This is the only subgroup of the genus which contains species found in the Oriental region. The three Oriental species are *C. orientalis*, *C. gibbosa* (the type-species of the genus) and *C. scutellaris*, which is also found in Africa.

Clavigralla tomentosicollis Stål

(Figs 187, 188, 191–202)

Clavigralla tomentocollis Stål, 1855 : 31. **LECTOTYPE** ♀, **SOUTH AFRICA** (NR, Stockholm), here designated (examined).

Clavigralla tomentosicollis Stål, 1865 : 107. [Emendation.]

Acanthomia tomentocollis (Stål) Stål, 1873 : 82.

Length: ♂, 8.3–9.7 mm, mean 9.1 mm ($n = 32$); ♀, 9.3–11.5 mm, mean 10.6 mm ($n = 30$). Form robust, oblong, deep-bodied.

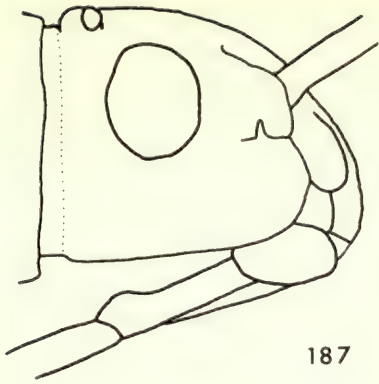
Head (Fig. 187) anteriorly declivent at an angle of about 45° to the vertical. Antennifers scarcely divergent, process at outer apical angle broad, deflexed. Bucculae occupying about one-third of length of ventral midline of head. Antennae with segment I slightly curved laterad and slightly thickened in its apical third, its length divided by width of head including eyes in male 1.17–1.39, mean 1.26 ($n = 30$), in female 1.10–1.32, mean 1.25 ($n = 30$). Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.85 : 0.72 : 1.03, in female about 1.00 : 0.88 : 0.75 : 1.01. Basal segment of rostrum at rest (Fig. 187) with apex distinctly posterior to level of posterior margin of eye; length of basal segment divided by width of head including eyes in male 0.68–0.81, mean 0.73 ($n = 30$), in female 0.63–0.83, mean 0.76 ($n = 30$). Ratio of lengths of rostral segments I : II : III : IV in male about 1.00 : 0.92 : 0.71 : 1.15, in female about 1.00 : 0.89 : 0.70 : 1.10.

Pronotum (Fig. 188) strongly declivent anteriorly, with a pair of large, blunt, sublateral tubercles; posterolateral angles bluntly projecting, each bearing a short, slender, laterally directed spine with slight anterior and upward curvature; width across apices of posterolateral spines divided by width of head including eyes in male 2.35–3.10, mean 2.70 ($n = 30$), in female 2.54–3.18, mean 2.87 ($n = 30$); pre-scutellar spines small, strongly divergent. Scutellum with disc very strongly convex. Metathoracic scent gland peritreme of the usual form for the species-group (Fig. 191). Apex of corium produced, at rest reaching posteriorly to level of about basal one-third of abdominal laterotergite VI. Anterior and intermediate femora each with a single small, subapical spine beneath, rarely with two; posterior femur (Fig. 192) with two major subapical spines beneath, the more distal about one and one-half times as long as the other, with about 5 very small spines or granules between them and a terminal series of 4 or 5 spines. Posterior tibia straight except for slight basal curvature (Fig. 192), its length divided by length of posterior femur in both sexes 0.68–0.88, mean 0.75 ($n = 60$).

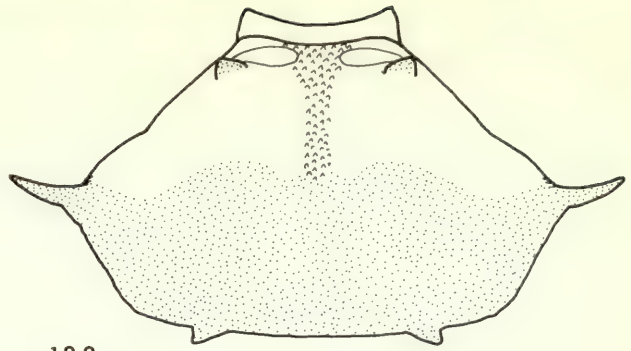
Abdominal sternites III–VII with posterior angles acute, slightly prominent (Fig. 193). Male genital capsule (Fig. 194) with lip filling posterior emargination, tongue trifid. Paramere (Fig. 198) with apex strongly incurved, acute, tooth at middle of blade strongly developed, blade scarcely broader than shaft. Conjunctiva (Figs 195–197) with dorsomedian lobe low, transverse, simple; distal dorsomedian lobe larger, transverse, with conical intermediate dorsal lobe arising from its anterior face and short, distal dorsolateral lobes arising at its lateral angles; posterior face of conjunctiva above base of vesica with a pair of T-shaped or capitate lobes slightly larger than distal dorsolateral lobes; apical ventral lobes about equal in size to these capitate lobes; distal ventrolateral lobes large, spreading, lightly sclerotized on their posterior faces; ventral lobes small, short and finger-like; no lobes, apart from distal ventrolaterals, sclerotized. Ejaculatory reservoir (Fig. 199) small, wings and straps long, sclerites protecting base of vesica small and closely associated with ejaculatory reservoir; vesica tightly coiled at base, moderately long. Female abdominal sternite VII cleft along rather less than half the length of its midline. Second valvula of ovipositor (Fig. 201) with small, rounded, apical prominence bearing about 10 stout bristles; ventral half of lateral surface with numerous, finer bristles. Spermatheca (Fig. 202) with duct short, not convoluted. Sclerites of dorsal wall of gynatrium (Fig. 200) V-shaped, anterior, spreading arms broad in slightly oblique vertical plane, median, longitudinal arms with half-hastate expansion in horizontal plane.

Head dorsally and laterally granulate, antennal segments I–III minutely granulate. Pronotum with declivent area, collar and lateral margins granulate, disc and posterior lobe granulate-punctate, with a few, very small tubercles. Scutellum granulate. Thoracic pleura granulate-punctate. Femora and abdominal laterotergites weakly granulate. Clavus seriatly punctate in three to four rows, corium weakly punctate, in basal half only; anterior veins in basal half with a few, coarse granules.

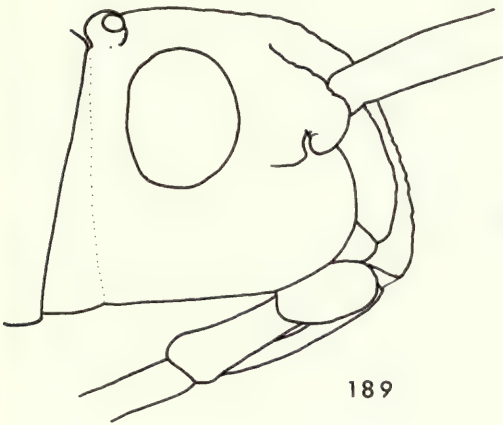
Head with short, decumbent, tomentose, silvery to golden pubescence throughout, interspersed with moderately long, suberect, colourless hairs and with a few, long, erect, colourless hairs along dorsal midline. Antennal segments I–IV with short, semidecumbent, colourless pubescence, I also with distinct, short, decumbent, silvery pubescence, traces of which are also present on II and III. Rostral segments I–IV with short, suberect, colourless pubescence, I and II also with decumbent, crisped, silvery pubescence. Pronotum (Fig. 188) in declivent part with dense pubescence composed of long, tomentose, silvery-white or slightly yellow hairs and long, erect, pale yellow to pale brown hairs, this area of pale pubescence completely divided into two halves by a median longitudinal band devoid of tomentose pubescence; posterior, horizontal lobe of pronotum with darker pubescence, the two areas of different coloured pubescence sharply demarcated, the junction between them following an undulating, transverse line between posterolateral angles of pronotum, two posterior projections of pale pubescence cause this line to undulate sharply in middle. Hairs of posterior lobe in band immediately adjacent to pale area short, erect, dark brown; remainder of this area with short, decumbent, crisped, golden-brown pubescence; posterior margin of pronotum fringed with long, erect, colourless hairs. Scutellum laterally and in posterior two-



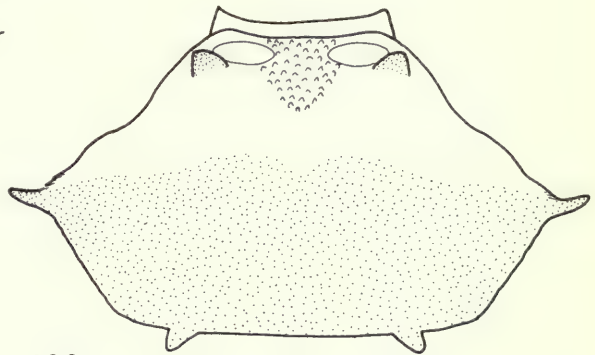
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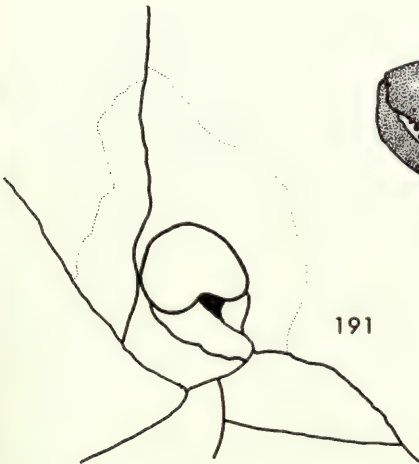
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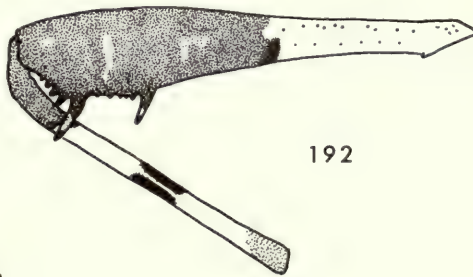
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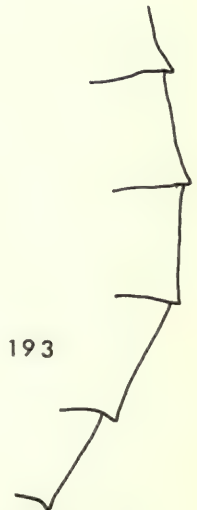
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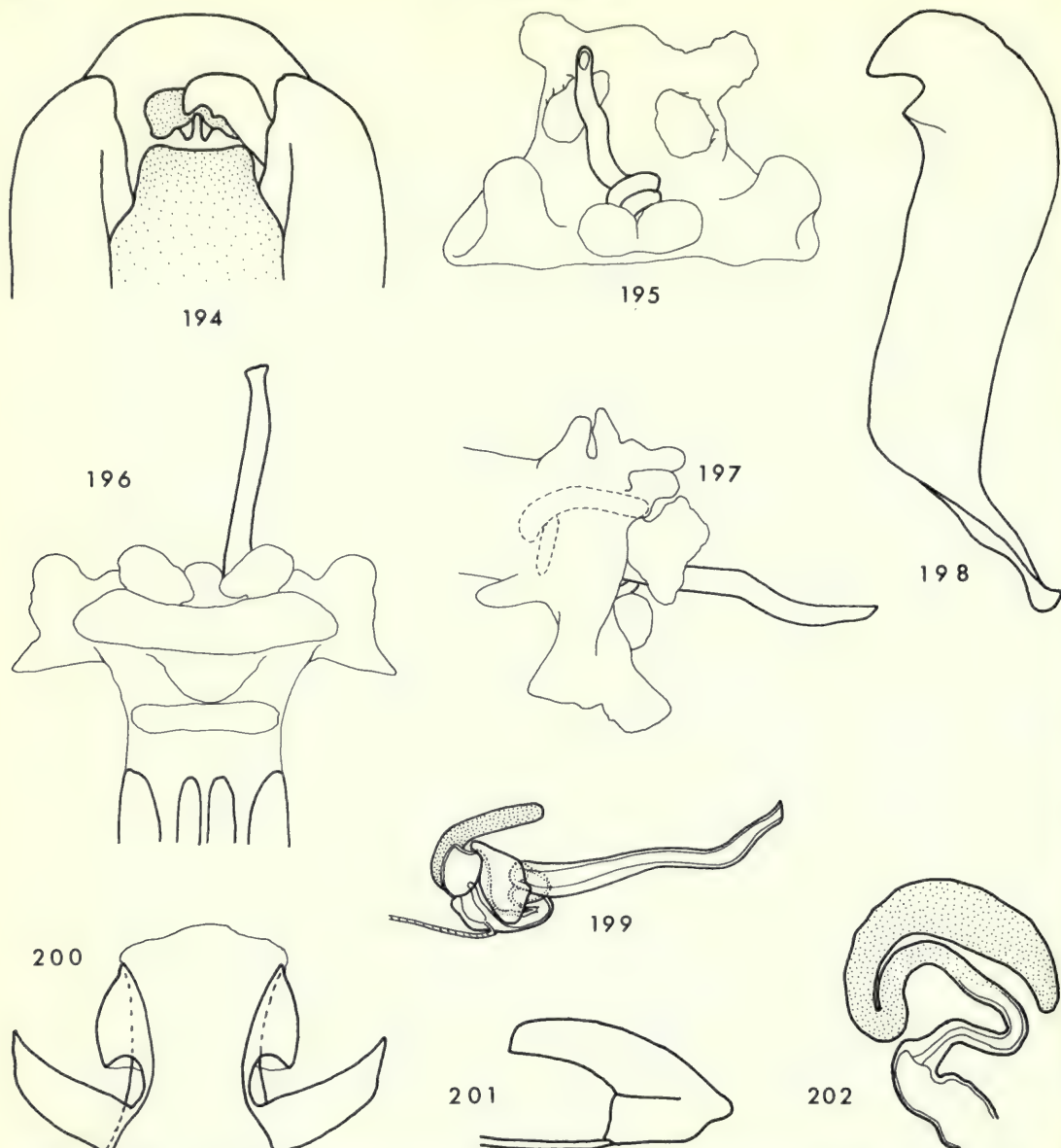


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193

Figs 187-193 *Clavigralla* species. (187) *tomentosicollis*, head of ♀, right lateral view; (188) same, ♀ pronotum, dorsal view; (189) *scutellaris*, head of ♀, right lateral view; (190) same, ♀ pronotum, dorsal view; (191) *tomentosicollis*, left metathoracic peritreme, lateral view; (192) same, right posterior femur and tibia of ♂, anterior view; (193) same, left lateral margin of ♀ abdominal sternites III-VII, ventral view.



Figs 194–202 *Clavigralla tomentosicollis*. (194) apical two-thirds of ♂ genital capsule, right paramere removed, dorsal view; (195) conjunctiva and vesica, posterior view; (196) same, dorsal view; (197) same, left lateral view (broken lines show position of wings and straps of ejaculatory reservoir complex); (198) left paramere, dorsal view; (199) ejaculatory reservoir complex, left lateral view with left wing and strap removed, right wing stippled, right strap obscured by body of reservoir; (200) sclerites of dorsal wall of gynatrium, dorsal view; (201) left second valvula, lateral view; (202) spermatheca.

thirds with long, erect, colourless and long, tomentose, silvery types of hair intermingled, anteriorly with two tufts of long, erect, dark brown hairs. Thoracic pleura, thoracic and abdominal sterna and abdominal laterotergites with short, decumbent, slightly tomentose, silvery pubescence; propleura and thoracic and abdominal sternites with sparse, short, erect, colourless hairs intermixed with the silvery ones; mesopleura and metapleura with similar but denser pubescence intermixed; laterotergites with very short, semi-decumbent, pale to dark brown pubescence. Clavus and corium with very short, sparse, crisped, decum-

bent, silvery to golden pubescence intermixed with very short, semidecumbent to suberect, pale to dark brown, bristle-like pubescence. Femora throughout and tibiae basally with short, rather sparse, decumbent, silvery to golden-brown pubescence; legs throughout, including these areas, with short, suberect to rather long, erect, colourless pubescence.

Head pinkish brown, dorsally with numerous granules piceous, laterally and ventrally almost entirely piceous except for stramineous bucculae. Antennae stramineous, often suffused pink, segment I usually with a few granules in basal half and a streak or blotch ventrolaterally in apical third piceous, apical one-quarter usually pinkish brown. Thorax and abdomen pinkish brown; main colour pattern of pronotum due to the pubescence, declivent area appearing off-white, completely divided by a dark, longitudinal band along midline where piceous granules are visible; large tubercles on lateral margins and a few scattered tubercles on disc piceous, projecting through indumentum; posterior lobe of pronotum rich brown, due to coloration of both surface and pubescence; posterolateral spines piceous or dark brown; scutellum pinkish brown, disc anteriorly piceous, colour mostly obscured by pubescence; thoracic pleura each usually with a large, brown or piceous, median macula; acetabula often brown; meso- and metasternum piceous; abdominal sterna with ill-defined stramineous or pale pinkish brown spots contrasting weakly with pinkish brown ground colour, sterna III–VII each with a small, stramineous spot in the middle of each lateral margin, sterna III and often IV medially and II–IV, V or VI laterally with poorly defined piceous areas; laterotergites each with a small, stramineous spot on lateral margin adjacent to stramineous spot on margin of corresponding sternum. Clavus and corium stramineous, suffused with pink or pinkish brown especially on veins and on apical one-third of corium, anterior veins of corium in basal half with a few large granules piceous. Membrane of hemelytron evenly infusate except for basal cells and veins of disc which are milky-hyaline. Legs stramineous; coxae and trochanters with large, piceous patches; each femur with apical half rufous brown with obscurely paler markings, apical area of darker colour where it borders on paler, basal area with a more or less extensive piceous band, so that junction between the pale and dark areas is abrupt and very distinct; all femora with a few, small spots in rows in basal halves piceous (Fig. 192); tibiae usually with basal and apical annuli red-brown and median penannular marking, interrupted on dorsal surface of tibia, piceous; all tarsal segments infusate apically, at least beneath.

Egg usually with 5–6 aeromicropyles in a ring.

REMARKS. Within its subgroup, this species is distinguished by its large size and almost straight posterior tibia from all species except *C. scutellaris*, from which it may be distinguished by a careful examination of the head shape, length of first rostral segment and details of the pronotal pubescence. A summary of morphometric variation in *C. tomentosicollis* and *C. scutellaris* is presented in Table 1. *C. tomentosicollis* is a common pest species throughout most of subsaharan Africa, though absent from the north-east (where it is replaced by *C. scutellaris*) and rare in forest areas including the Congo basin. Most records of '*Acanthomia brevirostris*' refer to this species. In economic literature the species is usually recorded as *Acanthomia tomentosicollis*. English names are 'bean bug' and 'spiny brown bug'. According to Smit (1964) it is called 'ysterbek' in Afrikaans. A colour figure is given by Bohlen (1973 : 33, fig. 158). Materu (1972) should be consulted for descriptions of the egg and nymphal instars. Recorded host-plants are 'beans' (*Phaseolus* spp.), cowpea (*Vigna*), hyacinth bean (*Dolichos*), chick pea (*Cicer*), pigeon pea (*Cajanus*) and *Tephrosia*. Publications on the pest status, biology and control include those of Fuller (1922), Anonymous (1926; 1927), Johnston (1930–1931), Smit (1964 : 134), Swaine (1969), Materu (1970; 1971), Materu & Makusi (1972; 1973), Bohlen (1973) and Taylor & Omoniyi (1972) discuss host-plant preference, pest status and variation in the morphology of the egg and the same paper and those of Taylor (1975) and Egwuatu & Taylor (1977a; 1977b) deal with various aspects of the parasitization of the eggs by *Gryon gnidus* (Nixon) (Hymenoptera : Scelionidae) and the same authors (1977c) give a detailed account of the biology of *C. tomentosicollis* under field and laboratory conditions.

DISTRIBUTION. Throughout the African mainland from Senegal and Sudan in the north to Cape Province in the south; absent from extreme north-eastern part of Ethiopian region (drier parts of Sudan and Kenya); present in Zanzibar and Comoro Is. but not recorded from other islands.

MATERIAL EXAMINED

Clavigralla tomentosicollis Stål, lectotype ♀, South Africa: 'Caffraria' (*J. Wahlberg*) (NR, Stockholm).

Numerous specimens from the following localities. **Senegal:** Bambey. **Gambia:** Jambour. **Ivory Coast:** Bouake. **Ghana:** Yapi; Tamale; Zuo; Jimle; Zau; Krachi; Abutia; Buriso. **Togo:** Sambu; Yendi; Sag-

Table 1 Morphometric variation in *Clavigralla tomentosicollis* Stål and *C. scutellaris* (Westwood)

	Length (mm)	Width of pronotum/ width of head	Length of IAS/width of head	Length of IRS/width of head	Length of posterior tibia/ length of posterior femur	Size of sample
Males						
<i>tomentosicollis</i>	8.8	2.65	1.27	0.73	0.77	
South Africa	(8.3–9.4)	(2.35–2.77)	(1.19–1.34)	(0.68–0.81)	(0.75–0.83)	10
<i>tomentosicollis</i>	9.1	2.66	1.29	0.75	0.75	
Central Africa	(8.6–9.7)	(2.51–2.84)	(1.18–1.39)	(0.69–0.79)	(0.73–0.77)	10
<i>tomentosicollis</i>	9.4	2.79	1.23	0.72	0.72	
West Africa	(8.8–9.7)	(2.56–3.10)	(1.17–1.28)	(0.68–0.74)	(0.70–0.75)	10
<i>scutellaris</i>	9.6	2.69	1.26	0.62	0.72	
Africa and Arabia	(8.8–10.3)	(2.58–2.81)	(1.18–1.39)	(0.55–0.66)	(0.69–0.77)	9
<i>scutellaris</i>	9.5	2.80	1.31	0.66	0.74	
Asia	(9.3–9.9)	(2.68–2.97)	(1.21–1.39)	(0.63–0.69)	(0.73–0.77)	5
Females						
<i>tomentosicollis</i>	10.2	2.77	1.26	0.77	0.76	
South Africa	(9.3–11.0)	(2.54–2.93)	(1.21–1.31)	(0.69–0.83)	(0.73–0.80)	10
<i>tomentosicollis</i>	10.4	2.84	1.28	0.77	0.76	
Central Africa	(9.8–11.1)	(2.70–3.05)	(1.24–1.32)	(0.73–0.81)	(0.73–0.88)	10
<i>tomentosicollis</i>	10.6	3.1	1.20	0.74	0.73	
West Africa	(9.8–11.5)	(2.67–3.18)	(1.10–1.27)	(0.63–0.78)	(0.68–0.80)	10
<i>scutellaris</i>	11.2	2.96	1.26	0.63	0.72	
Africa and Arabia	(10.3–12.2)	(2.73–3.12)	(1.15–1.38)	(0.56–0.67)	(0.68–0.76)	9
<i>scutellaris</i>	10.5	2.97	1.26	0.66	0.73	
Arabia	(9.8–11.3)	(2.81–3.12)	(1.16–1.32)	(0.58–0.76)	(0.70–0.76)	9

IAS: basal segment of antenna. IRS: basal segment of rostrum. Figures quoted are means, with ranges beneath in brackets. South Africa: Republic of South Africa only. Central Africa: Zaire, Zambia, Tanzania. West Africa: Ghana, Togo, Nigeria.

ranga. **Nigeria:** Ile-Ife; Zaria, Samaru; Samaru; Samaru, Dam; Samaru-Da; Kano, Gumel; Kano; Katsina Prov.; Malumfashi; Bida; Ibadan. **Zaire:** Faradje; Gandajika; Lubumbashi; Ngowa; Kwango; Albertville; Moliro. **Sudan:** Torit; W. Darfur; Gebel Murra, Killing, W. side of mountain. **Uganda:** Kampala; Entebbe; Eastern Prov., Kadunguru. **Kenya:** Ol Donto Sabuk; Rabai; Mombasa. **Tanzania:** Zanzibar; Ilonga; Arusha; Morogoro; Rukwa Drift, west escarpment; Kilimanjaro, west; Lake Manyara. **Malawi:** Zomba; Ruvo Valley; Mlanje. **Zambia:** Niamadzi River, near Nawalia; Mid Luangwa Valley; Serenje District. **Mozambique:** Valley of Kola River, near E. Mt Chiperone; Vila Paiva d'Andrada. **Rhodesia:** Salisbury; Sawmills; Bulawayo, Siloswe, Matopos; Hope Fountain. **Angola:** Vila Flor, Huambo. **Botswana:** Bakgatla, Sebele. **South West Africa:** Ovamboland, Oshikango. **South Africa:** Transvaal, Rustenburg; Tvl, Warmbaths; Tvl, Warmbad; Tvl, Towoomba; Tvl, 22 km NE. of Potgieterarus; Tvl, base Magoebaskloof; Tvl, Premiermyn; Tvl, Waterval Boven; Tvl, Tierpoort; Tvl, Pretoria; Tvl, Pretoria, Roodeplaat; Tvl, Silikat nek; Tvl Johannesburg; Tvl, Barberton; Natal, Lake St Lucia, Charters Creek; Natal, Port Shepstone; Natal, Scotsbrough; Natal, Zululand, Hedley; Natal, Zululand, Mtunzini; Natal, Howick; Natal, Tugela River near Weenen; Natal, Estcourt; Natal, Hilton; Natal, Greytown; Natal, Durban; Natal, Port St John; Natal, Selati, Zoutpansberg; Cape Province, Ceres; C. P., Krakeel; C. P., Krakeel River; C. P., Barrydale; C. P., Riversdal; C. P., Ladismith; C. P., Oudshorn; C. P., Outshorn; C. P., Port Elizabeth; C. P., Knysna District, Harkerville Forest Reserve; C. P., Alice; C. P., Stellenbosch; C. P., Ongeluks nek; C. P., Queenstown; C. P., Swellendam; C. P., Cape Town; C. P., Cape Peninsula, Camps Bay; C. P., Keurboom River; C. P., Du Toits Kloof.

Altitudes recorded on labels: mostly 300–1500 m; one locality in Sudan at 2100 m.

Host-plants recorded on labels: cowpea (*Vigna*) in Senegal, Nigeria, Tanzania and Botswana; pigeon pea (*Cajanus*) in Nigeria, Zaire and Rhodesia; *Dolichos lablab* Linnaeus in Ghana and

Tanzania; beans (*Phaseolus*) in Tanzania and South Africa; soya bean (*Glycine*) in Nigeria; *Tephrosia* in Gambia; 'peas' in Ivory Coast; unidentified legume in Nigeria; cotton (*Gossypium*) in Ghana; spinach (*Spinacea*) in South Africa and 'weeds' in Nigeria.

Habitats recorded on labels: mango orchard, vegetable garden, farm nutwoods and on plant bases.

Depositories of material: IRSNB, Brussels; NM, Bulawayo; University of Ife, Ile-Ife; UG, Legon; Duarte coll.; BMNH, London; AMNH, New York; PPRI, Pretoria; TM, Pretoria; CAS, San Francisco; IAR, Samaru; MRAC, Tervuren; Slater coll.

Clavigralla scutellaris (Westwood)

(Figs 189, 190)

Coreus scutellaris Westwood, 1842 : 24. Lectotype ♂, INDIA (UM, Oxford), designated by Dolling (1978 : 291) [examined].

Clavigralla scutellaris (Westwood) Dallas, 1852 : 514.

Acanthomia brevirostris Stål, 1873 : 82. Lectotype ♀, SUDAN (NR, Stockholm), designated by Dolling (1978 : 291). [Synonymized by Dolling, 1978 : 291.]

Length: ♂, 8.8–10.3 mm, mean 9.6 mm (n = 14); ♀, 9.8–12.2 mm, mean 10.8 mm (n = 18). Very similar indeed to *C. tomentosicollis*. A full account of this species is given by Dolling (1978 : 291–293). Morphometric data for this species are given in Table 1 (above), where *C. tomentosicollis* is compared. Additional data for African and Arabian specimens are as follows. Ratio of lengths of antennal segments I : II : III : IV in males about 1.00 : 0.84 : 0.71 : 1.05, in female about 1.00 : 0.85 : 0.73 : 1.03. Ratio of lengths of rostral segments I : II : III : IV in male about 1.00 : 0.91 : 0.76 : 1.19, in female about 1.00 : 0.92 : 0.76 : 1.16.

Head (Fig. 189) more strongly declivent than that of *C. tomentosicollis*, frons making an angle of about 30° with the vertical. Rostrum shorter, first segment at rest with apex reaching posteriorly to a point distinctly anterior to posterior margin of eye (see Fig. 189 and Table 1). Stål (1873 : 82) states that the antennae are shorter and the posterolateral angles of the abdominal sternites less prominent in this species than in *C. tomentosicollis*. These differences are not substantiated by the larger number of specimens now available.

Sculpture, pubescence and coloration as in *C. tomentosicollis* except that antennal segment I is almost uniform pinkish brown, median annuli of tibiae are evanescent and area of pale pubescence on pronotum is divided by a dark band for only its anterior half to two-thirds (Fig. 190) and extends posteriorly in a single median undulation.

REMARKS. This species is extremely close to *C. tomentosicollis*, from which it may be distinguished by the steeper declivity of the frons, the shorter rostrum and the slight difference in pronotal pubescence mentioned above. No differences between the two species could be discerned in either the male or female genitalia. Most records of '*Acanthomia brevirostris*' in the literature, including that of Johnston (1930), refer to *C. tomentosicollis*. I have seen no specimens attributable to this species from localities west of Sudan. Nixon's (1943) record of the egg parasite *Microphanus striaticeps* Dodd (Hymenoptera: Scelionidae), from '*Acanthomia brevirostris*' in Sudan could refer to either species; its hosts also include Pentatomidae. Authentic host-plant records are *Dolichos lablab* Linnaeus in South Yemen and *Cajanus cajan* (Linnaeus) Millspaugh in India.

DISTRIBUTION. A crescent-shaped area from Kenya through Arabia and Pakistan to western India.

MATERIAL EXAMINED

Coreus scutellaris Westwood, lectotype ♂, **India**: Gogo (UM, Oxford). *Acanthomia brevirostris* Stål, lectotype ♀, **Sudan**: Chartum (= Khartoum) (*Schauf*) (NR, Stockholm).

Kenya: 1 ♀, Marsabit Forest, 19.viii.1977, by sweeping (*J. H. Martin*); 1 ♂, Northern Frontier District, Wajir, 25.i.1955 (*I. Lansbury*); 1 ♂, S. Nyeri, vi.1949 (*van Someren*); 1 ♀, Lukenia, iii.1937 (*van Someren*) (BMNH, London). **Sudan**: 1 ♂, no precise locality, 16.iii.1926 (*G. R. F. Medani, F. G. S. Whitfield*); 2 ♀, Berber Prov., Lulua, 1908 (*H. H. King*); 3 ♂, 1 ♀, Ed Damer, 5–10.vii.1961 (*R. Linnavuori*) (BMNH, London). **Southern Yemen**: 3 ♂, 3 ♀, El Kod, xii.1957, on *Dolichos lablab* Linnaeus (*R. C. M. Darling*); 1 ♀, Wadi Dareija, SW. of Dhala, c. 1400 m, 6–9.xi.1937 (*H. Scott, E. B. Britton*) (BMNH, London). **Oman**: 1 ♀, Oman, Al Wafi, 18.iii.1976 (*K. M. Guichard*) (BMNH, London).

Extralimital specimens. **Afghanistan:** Nengrahar Province. **Pakistan:** Hangu, Hyderabad, Karachi. **India:** Hyderabad (A. P.), Bombay, Coimbatore, Thekkadi, Trivandrum, Chickballapur. (Moravské Museum, Brno; Karachi University; BMNH, London. For details see Dolling, 1978 : 293.)

Clavigralla annulipes Signoret **comb. rev.**

(Figs 203–208)

Clavigralla annulipes Signoret, 1860 : 943. Holotype, MADAGASCAR ('Musée de Naples', fide Bergróth, 1903 : 297) [not examined].

Acanthomia annulipes (Signoret) Bergróth, 1903 : 297.

Length: ♂, 9.4–10.1 mm, mean 9.7 mm ($n = 12$); ♀, 10.0–11.3 mm, mean 10.4 mm ($n = 11$). Similar in size and build to *C. tomentosicollis*, but differing in many details.

Antennifers almost parallel; head shape similar to that of *C. tomentosicollis*. Length of antennal segment I divided by width of head including eyes in male 1.08–1.28, mean 1.18 ($n = 12$), in female 1.14–1.22, mean 1.17 ($n = 11$). Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.82 : 0.74 : 1.11, in female about 1.00 : 0.81 : 0.72 : 1.03. Length of basal segment of rostrum divided by width of head including eyes in both sexes 0.66–0.75, mean 0.69 ($n = 6$). Ratio of lengths of rostral segments I : II : III : IV in male about 1.00 : 1.06 : 0.84 : 1.32, in female about 1.00 : 0.94 : 0.69 : 1.21.

Pronotum (Fig. 203) strongly declivent, posterolateral angles not prominent, each bearing a short, slightly posteriorly directed spine, disc with a few, short, blunt, projecting tubercles; posterior lobe with a low, transverse keel in middle, bisected by a more prominent longitudinal keel; width across apices of posterolateral spines divided by width of head including eyes in male 2.50–2.75, mean 2.63 ($n = 12$), in female 2.55–2.76, mean 2.65 ($n = 8$). Scutellum convex, midline depressed, apex slightly produced. Corium with apex slightly produced, at rest reaching posteriorly to level of suture between laterotergites V and VI. Posterior tibia distinctly arcuate in basal third, its length divided by that of posterior femur 0.69–0.74, mean 0.71 ($n = 6$).

Abdominal sternites III–VII with posterolateral angles acute, prominent (Fig. 204). Male genital capsule similar to that of *C. tomentosicollis*. Paramere (Fig. 205) rather similar to that of *C. tomentosicollis* but apex distinctly angled inwards, not curved. Conjunctiva (Figs 206–208) with dorsomedian lobe low, M-shaped, intermediate dorsal lobe conical, distal dorsomedian lobe obsolete, distal dorsolateral lobes rather large, almost globular, a pair of large, T-shaped lobes arising from posterior face of conjunctiva above origin of vesica, apical ventral, distal ventrolateral and ventral lobes similar in form to those of *C. tomentosicollis*; all lobes membranous. Vesica rather short. Female genitalia as for *C. tomentosicollis*.

Sculpture, pilosity and coloration generally as in *C. tomentosicollis*. Antennae with segment I entirely brown. Membrane of hemelytron evenly suffused with brown pigment except for colourless basal cells. Area of brown pubescence on posterior lobe of pronotum almost completely divided into two triangular areas by a band of pale, silvery hairs extending posteriorly from declivent area along raised midline of posterior lobe and enclosing a tuft of erect, brown hairs between the apices of the two lateral triangles. Scutellum with erect, slightly tomentose, pale golden to silvery pubescence, in an almost globular arrangement, very slightly embrowned anteriorly. Tibiae without median pigmented annuli, or annuli present but faint.

REMARKS. Within the *tomentosicollis*-subgroup this species seems to be more closely allied to *C. curvipes* and *C. simillima* than to *C. tomentosicollis* and *C. scutellaris* by reason of the distinctly curved posterior tibiae and the pattern of pronotal pubescence. It differs from *C. curvipes* and *C. simillima* and from the only other Malagasy species of the *tomentosicollis*-group, *C. pusilla*, by its larger size, and from the last named species by the even pigmentation of the hemelytral membrane.

DISTRIBUTION. Southern Madagascar.

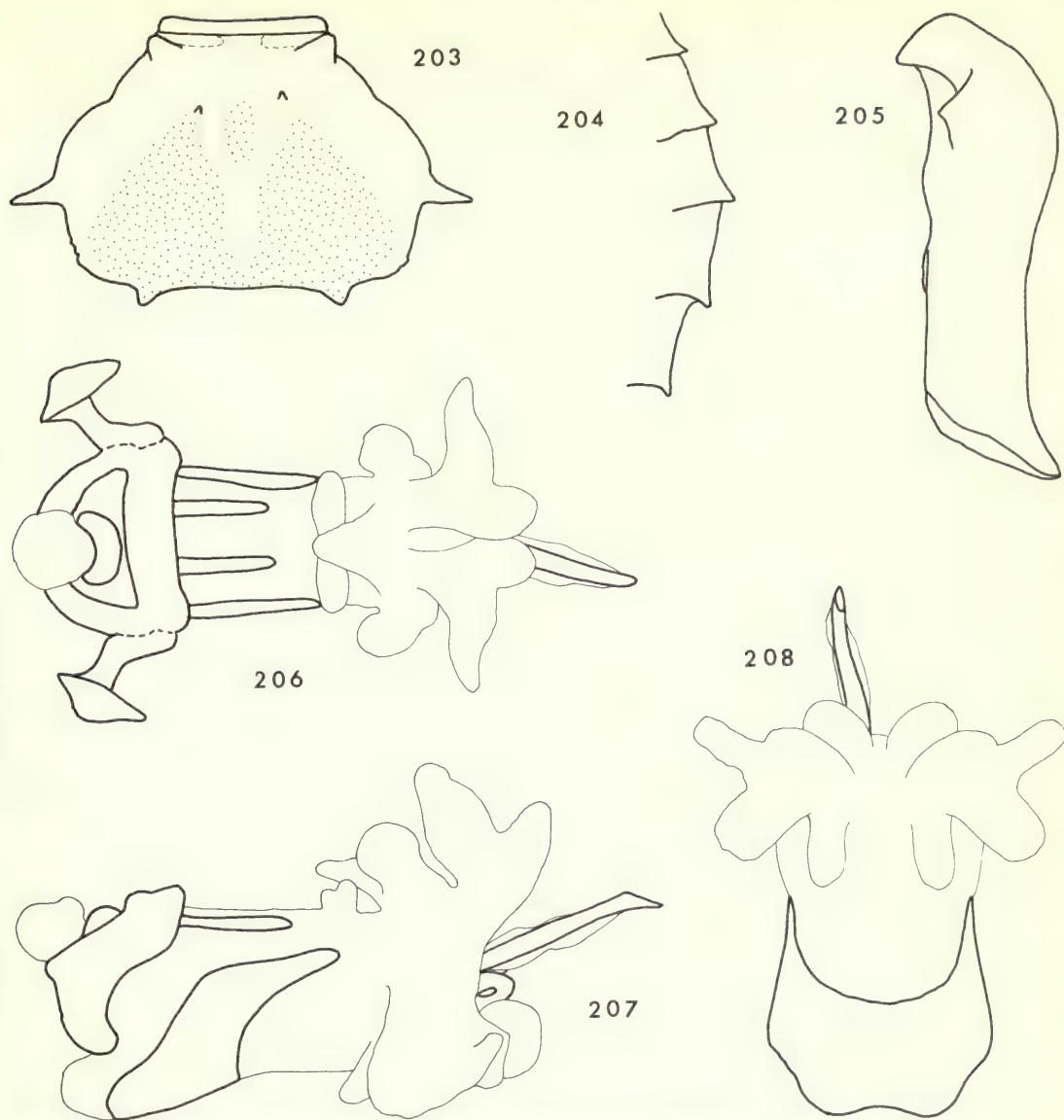
MATERIAL EXAMINED

Madagascar: 8 ♂, 10 ♀, Région Sud de l'Ile, Bekily, vi.1936 (*A. Seyrig*) (MNHN, Paris and BMNH, London); 3 ♂, 2 ♀, Ampandrandava (*Seyrig*) (MNHN, Paris); 1 ♂, Région du Sud, Andrahomana, 1901 (*Ch. Alluaud*) (MNHN, Paris).

Clavigralla curvipes (Stål) **comb. n.**

(Figs 211, 213–217)

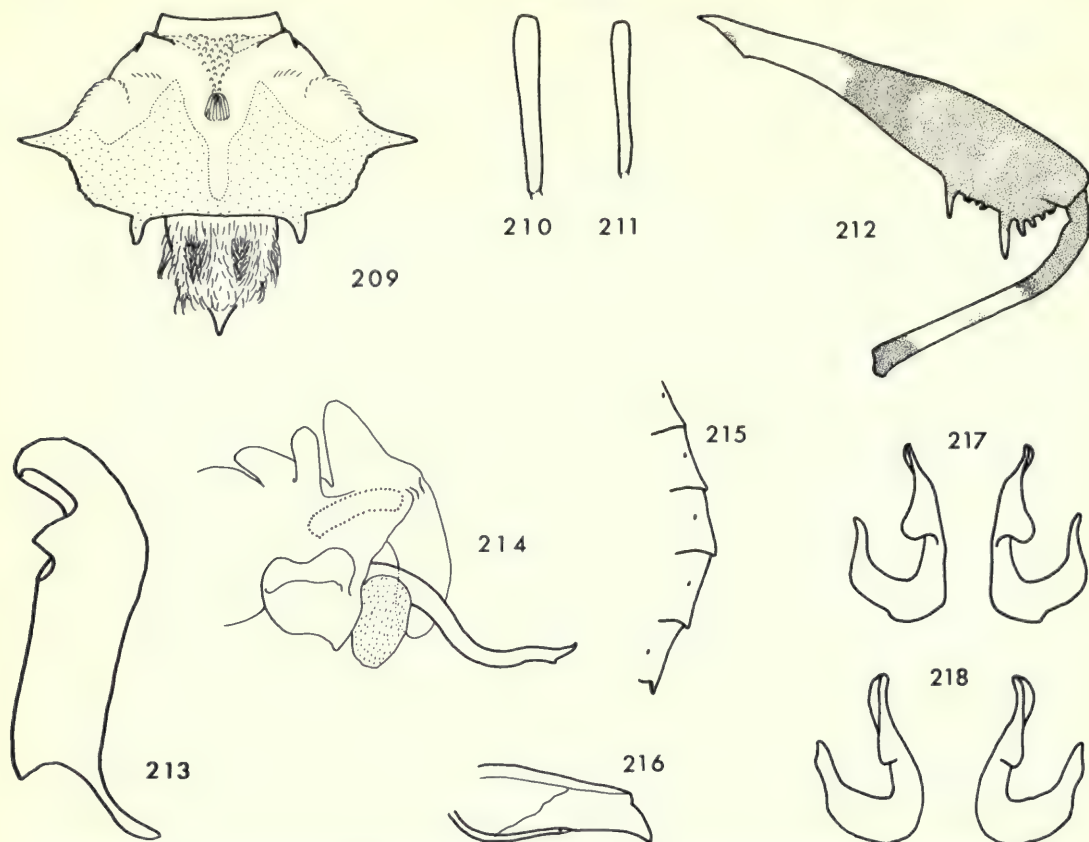
Acanthomia curvipes Stål, 1873 : 82. **LECTOTYPE** ♂, GUINEA-BISSAU (NM, Vienna), here designated [examined].



Figs 203–208 *Clavigralla annulipes*. (203) pronotum of ♀, dorsal view; (204) left lateral margins of ♂ abdominal sternites III–VII, ventral view; (205) left paramere, dorsal view; (206) aedeagus, dorsal view; (207) same, left lateral view; (208) same, ventral view.

Length: ♂, 7.3–8.3 mm, mean 7.8 mm ($n = 9$); ♀, 7.6–8.5 mm, mean 8.0 mm ($n = 8$). A small species, similar in build to the much larger *C. tomentosicollis* but with posterior tibia strongly arcuate at base, abdomen proportionally narrower and pubescence of pronotum differently organized.

Head short, antennifers parallel to slightly divergent. Antennal segment I (Fig. 211) slender, narrowest at a point about one-third of its length from base, then gradually increasing in thickness towards apex; length of this segment divided by width of head including eyes in male 1.03–1.13, mean 1.09 ($n = 9$), in female 1.00–1.06, mean 1.02 ($n = 8$). Ratio of lengths of antennal segments I : II : III : IV in male about 1.00 : 0.78 : 0.70 : 0.94, in female about 1.00 : 0.80 : 0.72 : 0.96. Length of basal segment of rostrum divided by width of head including eyes in both sexes 0.63–0.73, mean 0.67 ($n = 16$). Ratio of lengths of rostral segments I : II : III : IV in both sexes about 1.00 : 0.90 : 0.49 : 0.86; apex of rostrum at rest reaching disc of mesosternum.



Figs 209–218 *Clavigralla* species. (209) *simillima*, holotype ♂, pronotum and scutellum, dorsal view; (210) same, first antennal segment of ♀, dorsal view; (211) *curvipes*, first antennal segment of ♀, dorsal view; (212) *simillima* ♀, right posterior femur and tibia, posterior view; (213) *curvipes*, left paramere, dorsal view; (214) same, conjunctiva and vesica, left lateral view, outline of left wing of ejaculatory reservoir complex dotted; (215) same, left lateral margin of ♀ abdominal sternites III–VII, ventral view; (216) same, second valvula, lateral view; (217) same, sclerites of dorsal wall of gynatrium, dorsal view; (218) *simillima*, sclerites of dorsal wall of gynatrium, dorsal view.

Pronotum with posterolateral spines slender, directed laterally, slightly upcurved, width across apices of spines divided by width of head including eyes in male 2.24–2.72, mean 2.52 ($n = 5$), in female 2.39–2.64, mean 2.46 ($n = 7$). Scutellum rather strongly convex. Corium with apex produced, at rest reaching posteriorly to level of basal one-third of laterotergite VI. Posterior tibia strongly curved at base, its length divided by that of posterior femur 0.63–0.68, mean 0.66 ($n = 17$).

Abdomen with posterolateral angles of sternites III–VII (Fig. 215) acute, slightly projecting. Male genital capsule with lip rounded, tongue apically trifid. Paramere (Fig. 213) with strong tooth near middle of blade on dorsal surface and with apex strongly curved inward. Ejaculatory reservoir with wings and straps long; vesica of moderate length. Conjunctiva (Fig. 214) with dorsomedian lobe low, rounded, a pair of finger-like lobes arising from its base posterolaterally; intermediate dorsal lobe high, rather narrowly conical; distal dorsomedian and distal dorsolateral lobes obsolete; a large, downcurved, median lobe arising near top of posterior face of conjunctiva; apical ventral lobes large, with distinct surface roughness; distal dorsoventral lobes of the form usual in the genus; ventral lobes absent. Female with tergum IX distinctly but not strongly deflexed at apex. Second valvula of ovipositor (Fig. 216) bearing a prominent dorsal tooth. Sclerites of dorsal wall of gynatrium (Fig. 217) U-shaped, median arms with broad distal expansion. Spermatheca with bulb narrowly lunate, less than three times as wide as main part of duct, which is attached subterminally to it and is not convoluted but simply U-shaped; total length of duct about twice that of bulb, length of broad portion about two-thirds as long as bulb.

Sculpture and distribution of pubescence generally as for *C. tomentosicollis*. Junction between anterior, pale and posterior, dark areas of pronotal pubescence strongly M-shaped (as in *C. simillima*, Fig. 209), with an isolated tuft of erect, brown hairs in the triangle of pale pubescence between the anterior angles of the 'M'; pale pubescence extending posteriorly in a band along midline of posterior lobe to its posterior margin. Scutellum with two tufts of dark brown pubescence anteriorly on disc, otherwise with long, slightly tomentose, white pubescence shaped roughly into a hemisphere, not organized into spine-like tufts. Coloration in general as in *C. tomentosicollis* but usually with brown or piceous markings at apical border of corium more pronounced. Membrane of hemelytron suffused with brown, especially on disc, occasionally pigment also concentrated into 1 or 2 darker brown spots between bases of longitudinal veins where these arise from basal cells; veins themselves colourless except for bases of 2 longitudinal veins entering membrane from corium, which are dark brown.

Ovarian egg with 3 (in two cases) or 4 (in six cases) aeromicropyles.

REMARKS. The small size, pronotum shape, basally arcuate posterior tibiae and coloration distinguish this species from all others except *C. simillima*, which differs chiefly in the shape of the first antennal segment and the sclerites of the dorsal wall of the gynatrium.

DISTRIBUTION. This species occupies a band of territory between latitudes 15° N and 3° S from Guinea-Bissau to Uganda.

MATERIAL EXAMINED

Acanthomia curvipes Stål, lectotype ♂, **Guinea-Bissau**: 'Bissao' (in *Signoret* coll.) (NM, Vienna).

Ghana: 1 ♂, Legon, 14.viii.1964 (*S. A. Whyte*); 1 ♀, Legon, 29.xi.1968; 1 ♂, Legon, 1.ix.1968 (*R. Kumar*); 3 ♂, 1 ♀, Legon, 6.xii.1968 (*Kumar*); 1 ♂, 1 ♀, Tafo, 1.iv.1966, 3.i.1967, by pyrethrum knockdown from cocoa; 1 ♀, Tafo, 22.iv.1967; 1 ♀, Tafo, on ground, 15.ii.1956 (*D. Leston*); 1 ♂, Tafo, 19.i.1966, in u.v. light-trap (*Leston*); 1 ex. without abdomen, Keta, 8.xi.1967 (*Leston*); 1 ♂, Wegbe, V. R., 1.xi.1967 (*Leston*) (UG, Legon). **Togo**: 1 ♂, Missahoué, 650 m, vi.1963 (*Mme Y. Schach*) (MRAC, Tervuren). **Nigeria**: 2 ♂, N. Nigeria, Gusau, 1.ix.1975, at u.v. light (*L. E. Wallace, J. C. Deeming*) (IAR, Samaru); 1 ♂, 1 ♀, Bida, on weeds, 22.ix.1955; 1 ♀, N. W. State, 18 km NW. of Mokwa, Zugurma, in riparian rainforest by River Eku, 11–19.viii.1970 (*P. H. Ward*) (BMNH, London). **Zaire**: 2 ♂, 2 ♀, Faradje, 29° 40' E, 3° 40' N, i.1913 (*Lang, Chapin*) (AMNH, New York). **Uganda**: 1 ♂, Northern Buddu, 1160 m, 16–18.ix.1911 (*S. A. Neave*); 1 ♂, Kampala, 2–20.iv.1918 (*C. C. Gowdey*); 2 ♀, Kawanda, 11.iv.1940, on *Desmodium adscendens* De Candolle and 14.iv.1940 on 'lulimilumu' (*H. H.*) (BMNH, London). **Rwanda**: 1 ♂, Rubona, 1.v.1963 (*G. Pierrard*) (MRAC, Tervuren).

Clavigralla simillima sp. n.

(Figs 209, 210, 212, 218)

Length: ♂, 7.2–8.1 mm, mean 7.8 mm ($n = 5$); ♀, 7.8–8.5 mm, mean 8.1 mm ($n = 9$). Very similar indeed to *C. curvipes*.

Antennal segment I (Fig. 210) rather stout, of almost uniform thickness in the basal half, then expanding slightly and gradually towards apex. Length of antennal segment I divided by width of head including eyes in male 1.00–1.21, mean 1.09 ($n = 5$), in female 1.01–1.14, mean 1.09 ($n = 9$); ratio of lengths of segments I : II : III : IV in male about 1.00 : 0.78 : 0.70 : 1.00, in female about 1.00 : 0.77 : 0.68 : 0.91. Length of rostral segment I divided by width of head including eyes in both sexes 0.55–0.71, mean 0.65 ($n = 14$); ratio of lengths of segments I : II : III : IV about 1.00 : 0.91 : 0.48 : 0.87.

Width of pronotum across apices of posterolateral spines divided by width of head including eyes in male 2.57–2.65, mean 2.61 ($n = 4$), in female 2.44–2.75, mean 2.64 ($n = 7$). Length of posterior tibia (Fig. 212) divided by length of posterior femur 0.63–0.69, mean 0.65 ($n = 14$).

Male genitalia as in *C. curvipes* but vesica on average shorter. Second valvula of ovipositor with dorsal tooth less prominent than in *C. curvipes* and sclerites of dorsal wall of gynatrium (Fig. 218) with distal expansions of median arms less pronounced.

Pattern of pubescence on pronotum and scutellum (Fig. 209) and elsewhere and coloration and sculpture of integument as in *C. curvipes*.

REMARKS. This is clearly a sister-species to *C. curvipes*, differing little from it in appearance and morphology. There is a slight tendency to sexual dimorphism in the length of antennal segment IV, a phenomenon not encountered in *C. curvipes*, and the pronotal posterolateral spines are on average slightly longer. The differences in the form of the sclerites of the gynatrium are not as clear-cut as Figs 217 and 218 would suggest, since the median arms of these sclerites are broad in

the sagittal plane and a slight alteration in the angle from which they are viewed can result in a pronounced change of outline. Other characters of the genitalia do not provide reliable characters for separation of the species unless several specimens are available for comparison. However, the thickness of the first antennal segment is a reliable diagnostic character. It may be that the two populations treated here as species are not separated by a fertility barrier but only by the physical barriers of the Congo rainforest and the highlands of eastern central Africa.

DISTRIBUTION. The eastern half of southern Africa from Tanzania to Natal.

MATERIAL EXAMINED

Holotype ♂, **Tanzania**: E. Rukwa, 3500 ft (1100 m), iv.1938 (*D. G. MacInnes*) (BMNH, London).

Paratypes. **Tanzania**: 1 ♀, data as holotype (BMNH, London). **Zaire**: 2 ♀, Lubumbashi, 9.iii.1939, 30.iv.1939 (*H. J. Brédo*) (IRSNB, Brussels). **Malawi**: 1 ♂, SW. Lake Malawi, Monkey Bay, 2.v.1966 (NM, Bulawayo). **Mozambique**: 1 ♂, Chiluvo Hills, Vila Machado, 31.x.1967 (*E. Pinhey*) (NM, Bulawayo); 1 ex. without abdomen, Luabo, lower Zambesi River, viii.1957 (*P. J. Usher*) (TM, Pretoria). **South Africa**: 1 ♂, 'Stella Bush', xi.1905 (*Mailer*); 1 ♀, no data (probably leg. *Mailer*); 1 ♂, Natal, Durban (*J. P. Cregoe*); 1 ♀, Natal (*Bell Morley*); 1 ♀, Natal, Umbilo, 16.x.1914 (*L. Bevis*); 1 ♀, Natal, Port Shepstone, v.1897; 2 ♀, Natal, Malvern, vi.1897, 10.vi.1897; 1 ♀, Natal, Umkomaas River, 1897 (BMNH, London).

The *wittei*-subgroup

Tongue of male genital capsule bifid; pronotal disc with a pair of large, blunt, sublateral tubercles; membrane of hemelytron with a row of discrete, piceous spots, sometimes very pale, between bases of longitudinal veins. Pronotum with posterolateral angles more prominent than in other members of the *tomentosicollis*-group.

Clavigralla wittei (Schouteden) **comb. n.**

(Figs 219–221, 223–228)

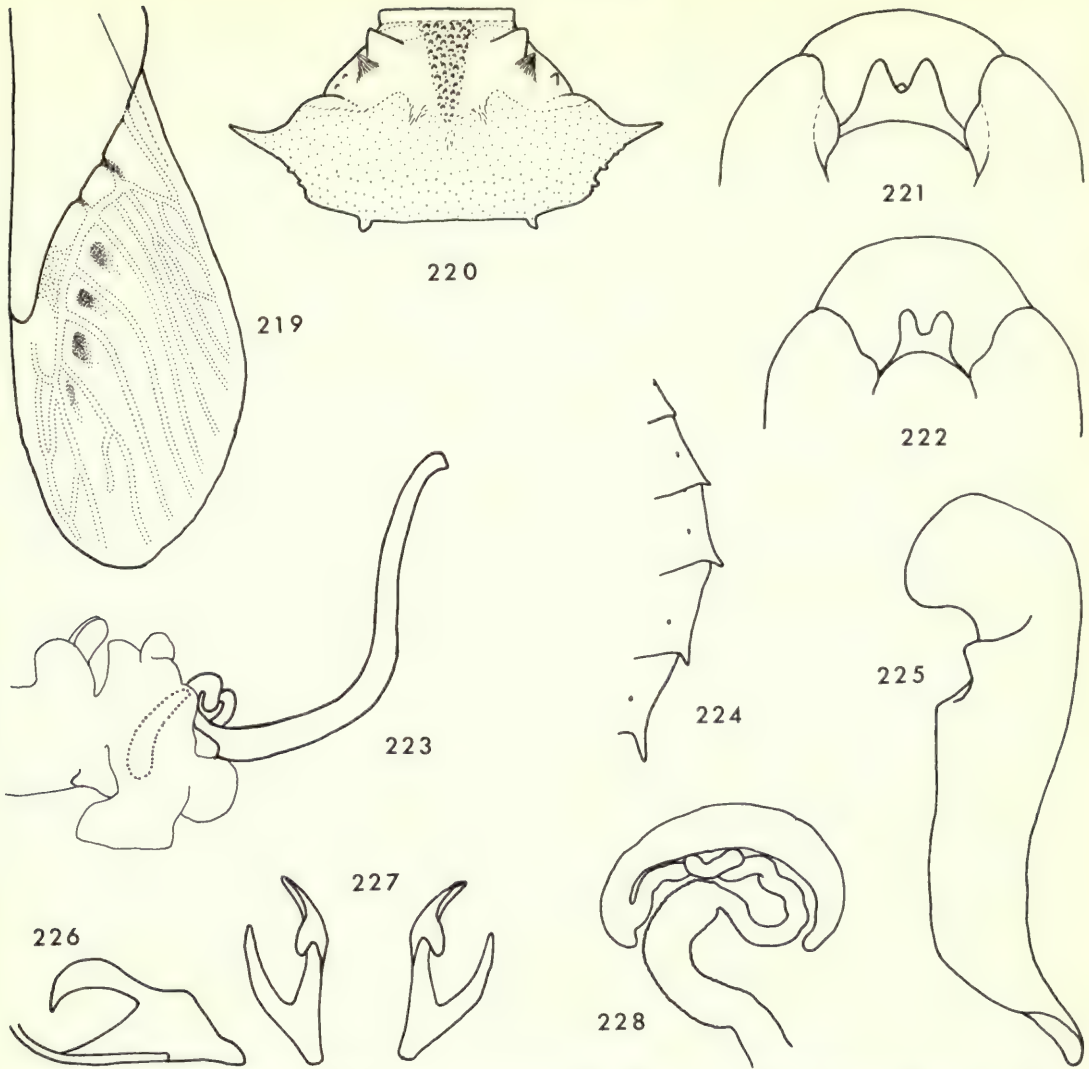
Acanthomia wittei Schouteden, 1938 : 291–292. LECTOTYPE ♂, ZAIRE (MRAC, Tervuren), here designated [examined].

Length: ♂, 7.6–9.5 mm, mean 8.5 mm ($n = 48$); ♀, 8.3–10.2 mm, mean 9.2 mm ($n = 56$). Of a rather more slender form than *C. tomentosicollis*, less deep-bodied, with more prominent pronotal posterolateral angles.

Antennifers slightly divergent. Length of antennal segment I divided by width of head including eyes in male 0.86–1.12, mean 0.99 ($n = 46$), in female 0.81–1.09, mean 0.95 ($n = 56$); ratio of lengths of segments I : II : III : IV in male about 1.00 : 0.75 : 0.72 : 1.32, in female about 1.00 : 0.76 : 0.73 : 1.28. Length of basal segment of rostrum divided by width of head including eyes in both sexes 0.62–0.81, mean 0.70 ($n = 103$); ratio of lengths of segments I : II : III : IV about 1.00 : 0.93 : 0.55 : 0.89.

Pronotum (Fig. 220) strongly declivent, posterolateral angles prominent, posterolateral spines slender, curved slightly upwards and slightly anteriad, usually long; margins of pronotum behind spines with a few prominent tubercles; width across apices of posterolateral spines divided by width of head including eyes in male 2.31–3.14, mean 2.80 ($n = 42$), in female 2.47–3.32, mean 2.87 ($n = 48$). Scutellum strongly convex. Corium with apex distinctly produced (Fig. 219), at rest reaching posteriorly to about level of middle of laterotergite VI. Anterior femur without subapical spines beneath or rarely with a single, very small one; intermediate femur usually with a single, small, subapical spine beneath, which is sometimes absent; posterior femur usually with 2–4 small spines between the two major spines. Posterior tibia almost straight, its length divided by that of posterior femur 0.68–0.79, mean 0.74 ($n = 97$).

Abdominal sternites III–VII with posterolateral angles (Fig. 224) produced into short, triangular spines. Male genital capsule (Fig. 221) with lip short, tongue deeply bifid, each half of tongue laminar, distinctly deflexed apically and laterally. Paramere (Fig. 225) strongly curved inward at apex, dorsomedial tooth of blade well developed, blade rather broad. Conjunctiva (Fig. 223) with dorsomedian lobe bearing a pair of small, finger-like lobes arising from its posterior face; intermediate dorsal and distal dorsomedian lobes low, conical; distal dorsolateral lobes absent; apical ventral lobes large, distal ventrolateral lobes of the form usual in the genus; ventral lobes poorly developed; posterior face of conjunctiva without prominent lobes. Ejaculatory reservoir complex with wings and straps long. Vesica very long, sclerites at its base large. Female sternum VII cleft for about half its median length. Second valvula (Fig. 226) with dorsal margin strongly undulating and apex produced into a lobe which is more weakly sclerotized than main body of valvula. Spermatheca (Fig. 228) with duct long, narrow portion convoluted. Sclerites of dorsal wall of gynatrium (Fig. 227) with large, anterodorsally directed tooth on each median arm.



Figs 219–228 *Clavigralla* species. (219) *wittei* ♂, apical half of left hemelytron, dorsal view; (220) same, pronotum of ♂, dorsal view; (221) same, apical half of ♂ genital capsule, dorsal view, with parameres removed; (222) *neavei*, holotype ♂, apical half of genital capsule with parameres removed, dorsal view; (223) *wittei*, conjunctiva and vesica, left lateral view, outline of left wing of ejaculatory reservoir complex dotted; (224) same, left lateral margin of ♀ abdominal sternites III–VII, ventral view; (225) same, left paramere, dorsal view; (226) same, second valvula, lateral view; (227) same, sclerites of dorsal wall of gynatrium, dorsal view; (228) same, spermatheca.

Pronotum and thoracic pleura granulate-punctate; head, antennae, legs, sterna and abdominal laterotergites weakly to very weakly granulate; major veins of clavus and corium with a few, small granules; clavus with three rows of rather small but deep punctures, corium near base weakly punctate. Abdominal terga I–VI and base of VII with fine, reticulate sculpture, I coarsely, and II finely, transversely furrowed, central one-third of III and IV with a few moderate sized to large punctures, III laterally and IV–VII with numerous, small punctures.

Head dorsally with sparse, long, erect, colourless pubescence, everywhere with fairly dense, short, decumbent and semidecumbent, silvery pubescence; antennal segment I with similar, short pubescence and some longer, suberect to erect hairs one-half to one times the width of the segment, II and III with semidecumbent pubescence about one-third as long as width of respective segments. Pronotum (Fig.

220) in declivent, anterior part with long, sparse, erect, colourless pubescence, shorter, brown, erect pubescence arising from granules in midline, a pair of pale to dark brown tufts on disc behind sublateral tubercles and of comparable size to these, and everywhere with dense, short to moderately long, slightly tomentose, silvery pubescence which extends onto anterior faces of the prominent posterolateral angles and is produced posteriorly into two tufts flanking midline; posterior, horizontal lobe of pronotum with dense, moderately long, brown pubescence which is erect anteriorly and decumbent posteriorly and laterally and with a poorly developed stripe of short, decumbent, silvery pubescence in part of midline. Scutellum with pubescence long, dense, slightly tomentose, silvery laterally and posteriorly, forming two brown tufts on disc anteriorly. Thoracic pleura with sparse, long, erect, colourless pubescence and with dense, shorter, slightly tomentose, silvery pubescence. Thoracic sterna with fairly dense, short, decumbent, crisped, silvery pubescence. Femora and coxae with fairly dense, short, decumbent, silvery pubescence, legs throughout with long, colourless, suberect to erect pubescence. Clavus, corium and abdominal laterotergites with dense, short, crisped, semidecumbent, brown and silvery hairs intermingled. Abdominal sternites with sparse, moderately long, suberect, colourless pubescence mixed with much denser and shorter, decumbent, slightly tomentose, silvery pubescence.

Coloration generally stramineous, variously suffused with pale pinkish brown, darker markings very variable in intensity and extent. Head typically with ocellar tubercles, ventral surface and most of lateral surfaces, apex of rostrum and a basal streak on lateral surface of antennal segment I brown to piceous. Anterior midline, tubercles and posterolateral angles and spines of pronotum, thoracic sterna, anterior half of disc of scutellum and two oblique streaks on each of the thoracic pleura piceous, posterior lobe of pronotum brown. Coxae, trochanters and femora except basal halves of intermediate and posterior pairs mottled with brown and piceous markings; tibiae usually with brown to piceous annuli at base, apex and middle. Corium with brown spotting or mottling on anterior veins and in apical one-third; hemelytral membrane (Fig. 219) milky hyaline with 2-4 discrete, brown spots between bases of longitudinal veins, bases of two veins where they enter membrane from corium brown; sometimes other, vaguer brown markings present at base of membrane. Abdominal sternites in middle with longitudinal markings and laterally with oblique stripes piceous or brown and variable in extent; laterotergites and corresponding area of tergite VII anteriorly each with a narrow, brown to piceous band, followed by a stramineous band which is narrow on segments III-V and broad on VI and VII, behind which is a broad, brown or piceous band continuous to posterior margin of each segment. Abdominal tergites varying from largely piceous with only a large spot above each abdominal scent-gland rudiment, a pair of lateral markings on tergites VI and VII and a narrow posterior border of VI and posterior half of VII stramineous, to a condition where tergites III-VII are largely stramineous or pale brown with piceous markings restricted to lateral areas of each tergite. Sometimes almost the entire ventral and lateral surfaces of the insect are piceous or black.

Ovarian egg with chorion strongly reticulate, each polygon of reticulation separately convex; about eight aeromicropyles present.

REMARKS. The posterolateral angles of the pronotum are more prominent in this species than in any other of the *tomentosicollis*-group. It is the most common species with distinct spots on the membrane of the hemelytron. Recorded host-plants which may be food-plants are *Schotia* (Leguminosae, Caesalpinaceae) and *Vigna*.

DISTRIBUTION. Widespread in western, eastern and southern Africa, less common in central Africa and apparently absent from South Africa except the Transvaal.

MATERIAL EXAMINED

Acanthomia wittei Schouteden, lectotype ♂, **Zaire**: Stanleyville (= Kisangani), v.1926, on *Schotia* (*Lt. J. Ghesquière*) (MRAC, Tervuren).

Ivory Coast: 1 ♂, Orumbe-boka, 11.x.1964 (*Gillon*); 2 ♂, 2 ♀, Man, 19.x.1968 (*J. Brenière*) (BMNH, London). **Ghana**: 2 ♂, Tafo, 13.xi.1965 (*Leston*) (BMNH, London); 1 ♂, 1 ♀, Tafo, 8.i.1967 (*R. Kumar*); 2 ♂, 1 ♀, Legon, Botanic Garden, 14.v.1967 (UG, Legon). **Nigeria**: 1 ♀, Ibadan, 21.iii.1955, on *Zea mays* Linnaeus leaf (*G. H. Caswell*) (BMNH, London); 2 ♂, 3 ♀, Zaria Province, Dumbi Wood, 26.x.1969, 15.xi.1969, 17.xi.1969 (*J. C. Deeming*); 1 ♀, Zaria, Samaru, 3.x.1971 (*Deeming*) (IAR, Samaru). **Zaire**: 1 ♂, Lake Tanganyika, Baie de Burton, 17.iv.1947 (*Miss. Tanganyika*); 1 ♀, near Mwashia, grassy plain, 1 km from saltpan, 3.v.1939 (*H. J. Brédo*) (IRSNB, Brussels); 1 ♂, Yangambi, ix-xii.1958 (*J. Decelle*); 1 ♀, Lulua, Muteba, i.1932 (*G. F. Overlaet*); 1 ♂, 2 ♀, Lulua, Kapanga, xii.1932 (*G. F. Overlaet*) (MRAC, Tervuren). **Uganda**: 12 ♂, 14 ♀, Kafu River, near Hoima, Kampala Road, 1050 m, 29-31.xii.1911 (*S. A. Neave*); 1 ♀, Entebbe, 5-9.iv.1914 (*C. C. Gowdey*) (BMNH, London). **Kenya**: 1 ♂, Mombasa Island,

Kilindini, 19–23.viii.1955 (*L. F. Brown*); 1 ♂, Mombasa, iv.1930 (*R. E. Dent*); 1 ♂, Maramas District, Ilala, 22 km E. of Mumias, 1350 m, 18–21.vi.1911 (*S. A. Neave*); 1 ♂, 2 ♀, Naivasha, vii.1937 (*H. J. A. Turner*) (BMNH, London). **Tanzania**: 2 ♂, 1 ♀, Mbeya Mt, 33° 25' E, 8° 48' S, 2100 m, trees and herbage on grass slopes, 5.viii.1959 (*Cambridge E. African Exped.*); 1 ♀, Elton Plateau, 2100 m, 34° 10' E, 9° 20' S, 7.viii.1959 (*Cambridge E. African Exped.*) (BMNH, London). **Malawi**: 1 ♀, Zomba (*H. S. Stannus*); 2 ♂, 4 ♀, Mlanje, 23.iv.1913, 2.vi.1913, 13.vi.1913 (*S. A. Neave*) (BMNH, London). **Botswana**: 1 ♀, Batawana, Totena, 9.v.1968, on cow pea (*Vigna* sp.) (*R. E. Roome*) (BMNH, London). **Zambia**: 1 ♂, Mweru-Wantipa, 1944 (*H. J. Brédo*) (IRSNB, Brussels). **Rhodesia**: 3 ♀, Bindura, ii.1959 (NM, Bulawayo). **South Africa**: 15 ♂, 15 ♀, Transvaal, Waterburg District, Plat River, 6–18.iv.1905 (*C. Swierstra*) (TM, Pretoria).

Clavigralla neavei sp. n.

(Fig. 222)

Length: ♂, 6.75–7.0 mm ($n = 2$). Female unknown. Very similar to *C. wittei* but smaller and with pronotal posterolateral angles less prominent.

Length of antennal segment I divided by width of head including eyes 0.89–0.94 ($n = 2$); length of segments II and III divided by length of segment I in holotype 0.74 and 0.64 respectively, these segments missing in paratype, IV missing in both specimens. Length of basal segment of rostrum divided by width of head including eyes 0.68–0.73 ($n = 2$).

Pronotum with posterolateral angles less prominent than in *C. wittei* and spines shorter, width across apices of spines divided by width of head including eyes 2.45–2.52 ($n = 2$). Length of posterior tibia divided by that of posterior femur 0.73–0.78 ($n = 2$).

Posterolateral angles of abdominal sternites less strongly produced than the average for *C. wittei*. Lip of male genital capsule (Fig. 222) more prominent than in *C. wittei* and tongue narrower, the two lobes cylindrical, apically rounded, the sinus between them U-shaped, not V-shaped as in *C. wittei*.

Other features, including sculpture, pubescence and coloration, as for *C. wittei*.

REMARKS. Could be confused with small specimens of *C. wittei* but distinguished by the form of the tongue of the male genital capsule.

DISTRIBUTION. Central Africa.

MATERIAL EXAMINED

Holotype ♂, **Uganda**: Entebbe, 12–20.i.1912 (*S. A. Neave*) (BMNH, London).

Paratype. **Zaire**: 1 ♂, Lubero, 14.viii.1932 (*L. Burgeon*) (MRAC, Tervuren).

Clavigralla alpica (Bergróth) comb. n.

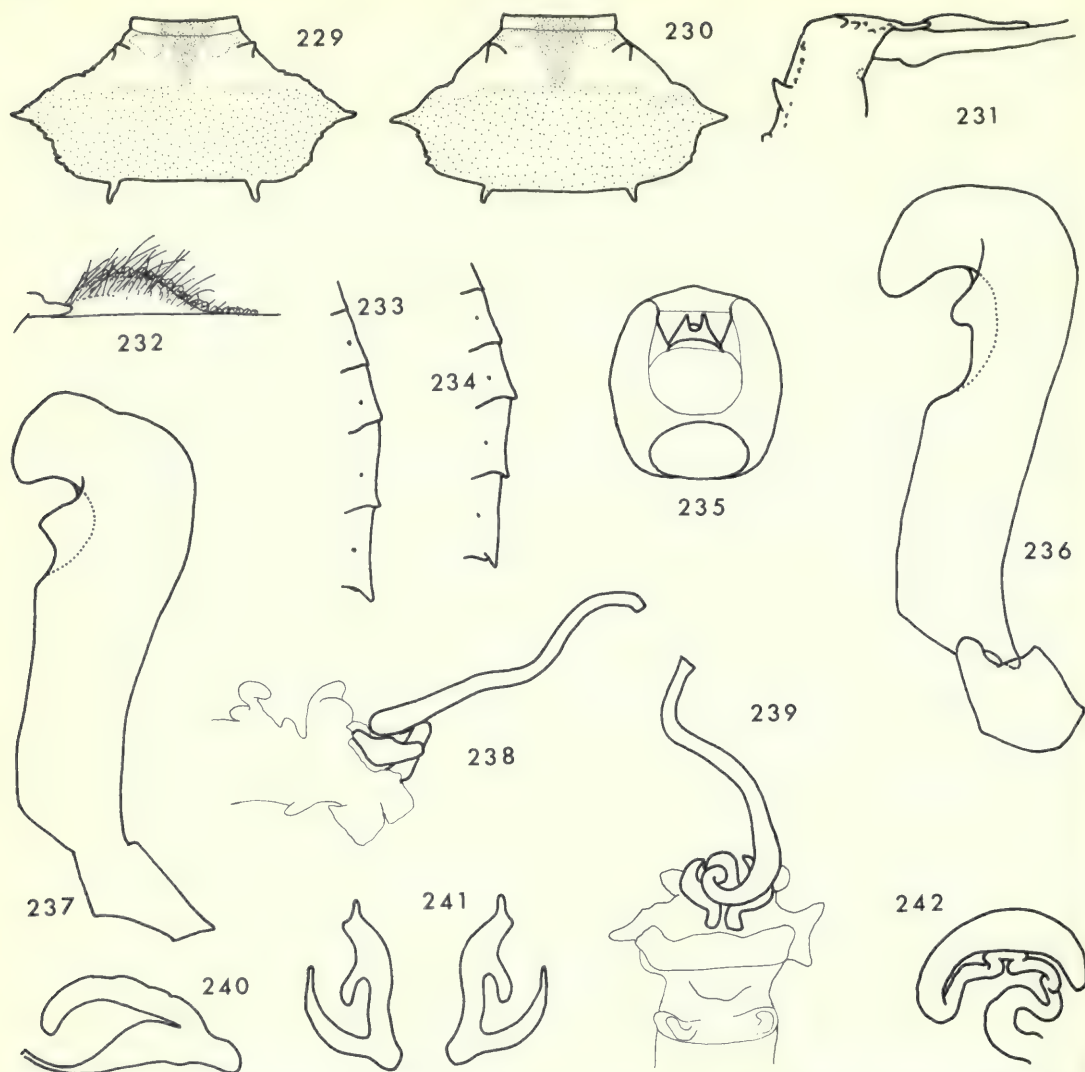
(Figs 229, 231, 233, 235, 236, 238–242)

Acanthomia alpica Bergróth, 1927 : 10. LECTOTYPE ♀, ZAIRE (NR, Stockholm), here designated [examined].

Length: ♂, 7.1–7.7 mm, mean 7.3 mm ($n = 9$); ♀, 7.3–8.3 mm, mean 7.7 mm ($n = 12$). Form depressed in comparison with other species of the genus.

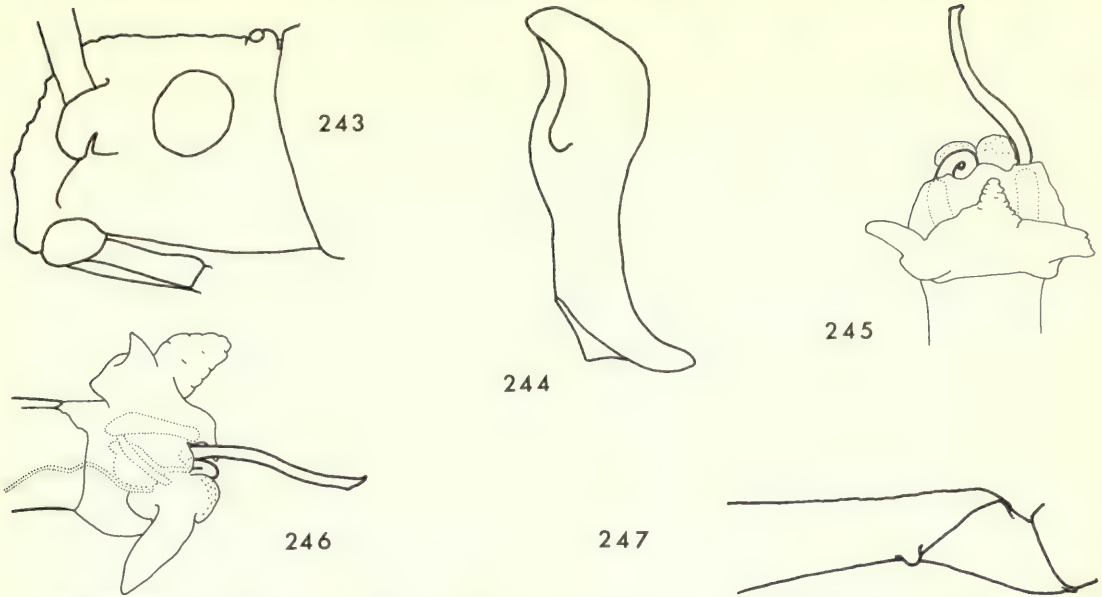
Antennifers slightly divergent. Antennae short, length of segment I divided by width of head including eyes in male 0.64–0.69, mean 0.66 ($n = 9$), in female 0.59–0.72, mean 0.64 ($n = 12$). Ratio of lengths of segments I : II : III : IV in male about 1.00 : 1.05 : 0.95 : 1.54, in female about 1.00 : 1.08 : 0.98 : 1.50; segment I shortly fusiform. Length of basal segment of rostrum divided by width of head including eyes in both sexes 0.68–0.76, mean 0.73 ($n = 18$), ratio of lengths of segments I : II : III : IV about 1.00 : 0.93 : 0.51 : 0.77.

Pronotum (Figs 229, 231) strongly declivent despite dorsoventral compression of body, its posterolateral angles strongly produced as in *C. wittei* but bearing much shorter spines; width across apices of posterolateral spines divided by width of head including eyes in male 2.33–2.55, mean 2.47 ($n = 8$), in female 2.28–2.75, mean 2.45 ($n = 12$). Scutellum (Fig. 231) weakly convex. Corium with apex produced, at rest reaching posteriorly to level of middle of laterotergite VI. Anterior and intermediate femora without or each with a very small subapical spine beneath, posterior femur usually with two major spines, the more proximal about half the length of the other, and an apical series of four spines; rarely 1 or 2 small spines are present between the major spines of the posterior femur and in one abnormal specimen examined there was an additional rather large spine just proximal to the first major spine. Posterior tibia not curved at base, its length divided by length of posterior femur 0.78–0.86, mean 0.82 ($n = 15$).



Figs 229-242 *Clavigralla* species. (229) *alpica*, ♂ pronotum, dorsal view; (230) *montana*, holotype ♂, pronotum, dorsal view; (231) *alpica*, left lateral profile of pronotum, scutellum and base of corium of ♂; (232) *montana*, holotype ♂, scutellum, left lateral view; (233) *alpica*, left lateral margins of ♂ abdominal sternites III-VII, ventral view; (234) *montana*, holotype ♂, left lateral margins of abdominal sternites III-VII, ventral view; (235) *alpica*, ♂ genital capsule, dorsal view, parameres removed; (236) same, left paramere, dorsal view; (237) *montana*, holotype, left paramere, dorsal view; (238) *alpica*, conjunctiva and vesica, left lateral view; (239) same, conjunctiva and vesica, dorsal view; (240) same, second valvula, lateral view; (241) same, sclerites of dorsal wall of gynatrium, dorsal view; (242) same, spermatheca.

Abdominal sterna III-VII with posterolateral angles (Fig. 233) very slightly prominent, acute. Male genital capsule (Fig. 235) with posterior emargination completely obliterated by lip, tongue deeply bifid. Paramere (Fig. 236) with apex hooked. Conjunctiva (Figs 238, 239) with dorsomedian lobe large, flat-topped, its posterolateral angles produced posteriorly into small, round, accessory lobes; intermediate dorsal, distal dorsomedian and distal dorsolateral lobes present but small; apical ventral and distal ventrolateral lobes moderately well developed; small ventral lobes present; vesica long. Female with second valvula of ovipositor (Fig. 240) strongly sclerotized, apex very prominent, dorsal surface strongly corrugated. Spermatheca (Fig. 242) with duct moderately and variably convoluted. Sclerites of dorsal wall



Figs 243–247 *Clavigralla annectans* and *Myla* sp. (243) *C. annectans*, holotype ♂, head, left lateral view; (244) same, left paramere, dorsal view; (245) same, inflated conjunctiva and vesica, dorsal view, outline of apices of 'wings' of ejaculatory reservoir complex dotted; (246) same, inflated conjunctiva and vesica, left lateral view, ejaculatory reservoir and associated structures indicated by dotted outlines; (247) *Myla* sp., left posterior trochanter and base of femur, posterior face.

of gynatrium (Fig. 241) with a large, barb-like process situated at about middle of median, longitudinal arms.

Sculpture and distribution of pubescence generally as in *C. tomentosicollis* but decumbent pubescence much less dense and all erect and suberect pubescence short, no hairs as long as transverse diameter of an eye. Coloration of head, exposed areas of thorax and abdomen, clavus, corium and apical two-thirds of femora pinkish brown with varying amounts of piceous coloration. Ventral surface of head, mesosternum, metasternum, disc of abdominal venter piceous. Head laterally streaked piceous, dorsally with only granules piceous or more or less heavily streaked piceous throughout. Antennal segment I always with a larger or smaller ventral piceous streak, at least towards base. Rostrum of variable coloration. Pronotum with rather sparse pubescence compared with that of other members of the *tomentosicollis*-group, dividing line between anterior, decumbent, silvery pubescence and posterior, erect to decumbent, brown pubescence almost straight (Fig. 229), posterolateral margins, patch in anterior midline of disc and at least apices of sublateral tubercles piceous, punctures of posterior region of disc often piceous. Scutellum black, with apex and distal half or more of midline cream, with pubescence along midline silver, elsewhere black or brown. Thoracic pleura and abdominal sterna more or less heavily streaked piceous; dorsal midline of abdomen always pale, cream or buff, remainder of tergites largely piceous; laterotergites and corresponding areas of tergum VII dark brown or piceous, IV and V each with a narrow band and VI and VII each with a broad transverse band buff. Corium with punctures and veins apically more or less heavily marked with brown or piceous, punctures of clavus sometimes piceous. Hemelytral membrane hyaline, with faint to well-marked brown streaks between longitudinal veins and a row of piceous spots between bases of longitudinal veins where these arise from basal cells. Femora moderately to heavily marked with piceous streaks and spots, especially on posterior surfaces, sometimes almost wholly piceous. Tibiae stramineous, basally and sometimes apically, but never medially, with darker, brown or partly piceous annuli.

REMARKS. This species varies considerably in colour, specimens from Ethiopia being in general the palest, with less extensive piceous markings than those from central Africa. Apparently restricted to areas above the 2000 m contour. The compressed form and very short pubescence distinguish this species from all of its congeners.

DISTRIBUTION. Highlands of central Africa and Ethiopia. Schouteden (1957 : 308) records this species from Rwanda and Burundi.

MATERIAL EXAMINED

Acanthomia alpica Bergröth, lectotype ♀, **Zaire**: Mt Muhavura, Birunga, 2500 m (*Pr. W. Exp., Gylde*) (NR, Stockholm).

Ethiopia: 1 ♀, Gamo Province, Mt Tola (Gughe highlands), c. 3200 m, 10–14.xii.1948 (*H. Scott*); 1 ♀, edge of Djem-Djem Forest, c. 2700 m, 4.x.1926 (*Scott*); 1 ♀, Simien, below Atgheba Ghiyorghis, c. 3200 m, from wet rocks below a spring, 7.xii.1952 (*Scott*); 1 ♀, Simien, near Enchetcab, above 2700 m, beneath large stones round drinking pool for cattle, 25.xii.1952 (*Scott*); 1 ♀, Simien, Arghine, 3500 m or higher, near torrent in peat soil, under boulders or at roots of plants, 24.xi.1952 (*Scott*) (BMNH, London). **Zaire**: 1 ♀, Birunga, Kariss, 3000 m (*Pr. W. Exp., Gylde*) (paralectotype of *Acanthomia alpica* Bergröth) (NR, Stockholm). **Uganda**: 1 ♀, Butandiga, 12.i.1930 (*H. Hargreaves*) (BMNH, London). **Kenya**: 1 ♂, Muguga, 28.i.1969 (*E. S. Brown*) (UM, Oxford); 1 ♀, Naivasha, ix.1939 (*H. J. A. Turner*); 7 ♂, 1 ♀, West Aberdares, 3700 m, xii.1935 (*Turner*); 3 ♀, West Aberdares, 3000–3500 m, xi.1934 (*A. F. J. Gedye*); 1 ♂, Londiani, v.1936 (*Turner*); 1 ex. without abdomen, Kinangop, iii.1930 (*Turner*) (BMNH, London).

Clavigralla montana sp. n.

(Figs 230, 232, 234, 237)

Length: ♂, 7.3 mm (n = 1). Known only from the unique male holotype. Very similar to *C. alpica* in general form and in many details.

Length of antennal segment I divided by width of head including eyes 0.80. Ratio of lengths of antennal segments I : II : III : IV as 1.00 : 0.86 : 0.75 : 1.35. Length of basal segment of rostrum divided by width of head including eyes 0.66, ratio of lengths of rostral segments I : II : III : IV as 1.00 : 0.93 : 0.50 : 0.81.

Pronotum (Fig. 230) with posterolateral angles less strongly produced than those of *C. alpica* but bearing slightly longer spines; width across apices of spines divided by width of head including eyes 2.41. Scutellum (Fig. 232) distinctly more convex than that of *C. alpica*. Length of posterior tibia divided by length of posterior femur 0.81.

Abdominal sternites III–VII with posterolateral angles (Fig. 234) acutely produced, more prominent than in *C. alpica*. Male paramere (Fig. 237) with apical margin distinctly notched. Coloration as in darker examples of *C. alpica*, except that tibiae, tarsi, ground coloration of femora and antennal segments I–III red. Pubescence distinctly longer than that of *C. alpica*, many of the outstanding hairs on head, thorax and appendages as long as transverse diameter of an eye (e.g. pubescence of scutellum, Fig. 232).

REMARKS. Obviously very closely related to *C. alpica*, from which it may be distinguished by the longer pubescence and other characters presented above. This species probably occupies the same montane niche in West Africa as that favoured by *C. alpica* in Ethiopia and central Africa.

DISTRIBUTION. Cameroun mountains.

MATERIAL EXAMINED

Holotype ♂, **Cameroun**: Bamenda, 17.xiii.1955 (*Bechyne*) (BMNH, London).

Nomenclature of economically important species

As a result of this revision it has proved necessary to make changes in the names of the African species formerly referred to the genus *Acanthomia* Stål (variously mis-spelt in collections and published work as *Acanthomya* and *Acanthomyia*). This generic name falls as a synonym of *Clavigralla* Spinola, thus placing the African 'pod bugs' or 'spiny brown bugs' in the same genus as the Indian minor pest known as the 'tur pod bug', *Clavigralla gibbosa*, which has been the subject of several biological and anatomical studies (for details of which see Dolling, 1978 : 288–289).

The well-known and widespread *Acanthomia tomentosicollis* (Stål) reverts to *Clavigralla tomentosicollis* Stål and the less important '*A. brevirostris*' is shown to be restricted to a small area in the north-eastern part of the Ethiopian region, southern Arabia and parts of the Oriental region, its correct name being *Clavigralla scutellaris* (Westwood).

The minor pest species known as *A. hystricodes* (Stål) reverts to *Clavigralla hystricodes* Stål.

The name *Acanthomia horrida* (Germar), correctly applied, should refer (as *Clavigralla horrida* (Germar)) to an economically unimportant species with a restricted distribution in South Africa and Rhodesia. In West Africa the name *horrida* has been misapplied to the pest species which should now be called *Clavigralla shadabi* Dolling. The same name has been misapplied in East and

Southern Africa to a different species for which the name *Clavigralla elongata* Signoret is available. Both *shadabi* and *elongata* are widespread in Zaire.

Check-list of the species of the tribe Clavigrallini

CLAVIGRALLOIDES Dolling

- acantharis* (Fabricius)
- tuberculata* Dallas
- spinigera* Walker
- spinosus* Dolling
- quadrītuberculatus* (Breddin)
- enkidu* Dolling
- tuberosus tuberosus* (Hsiao)
- tuberosus indicus* Dolling

GRALLICLAVA Dolling

- indica* Dolling
- soror* Dolling
- rubra* Dolling
- solitaria* Dolling
- insularia* Dolling
- montana montana* Dolling
- montana sinensis* Dolling
- dissimilis* Dolling
- horrens horrens* (Dohrn)
- spinofemoralis* Shiraki
- horrens palawanensis* Dolling
- indecora* (Walker)
- irianensis* Dolling
- australiensis* Dolling

ONCASPIDA Stål

- pilosicollis* (Stål)
- similis* Signoret

CLAVIGRALLA Spinola

- Acanthomia* Stål syn. n.
- Lancha* Shadab syn. n.
- tuberculicollis* (Reuter) comb. n.
- leroyi* (Schouteden) comb. n.
- mixta* (Schouteden) syn. n.
- zambiae* sp. n.
- uelensis* (Schouteden) comb. n.
- hystrix* Dallas
- hystricodes* Stål
- elongata* Signoret
- flavipennis* Signoret

- shadabi* sp. n.
- breviceps* sp. n.
- ankatsoensis* sp. n.
- madagascariensis* sp. n.
- asterix* sp. n.
- schnelli* (Villiers) comb. n.
- mira* sp. n.
- annectans* sp. n.
- insignis* (Distant) comb. n.
- minor* (Schouteden) comb. n.
- andersoni* sp. n.
- angolensis* sp. n.
- egregia* sp. n.
- longispina* sp. n.
- aculeata* sp. n.
- horrida* (Germar)
- muricata* Stål syn. n.
- natalensis* Stål
- leontjevi* (Bergróth) comb. n.
- griseola* (Linnavuori) comb. n.
- ruandana* (Schouteden) comb. n.
- biston* sp. n.
- oxonis* sp. n.
- bovilla* sp. n.
- pusilla* sp. n.
- strabo* sp. n.
- pabo* sp. n.
- spiniscutis* (Bergróth) comb. n.
- marmorata* sp. n.
- tomentosicollis* Stål
- tomenticollis* Stål
- scutellaris* (Westwood)
- brevirostris* Stål
- annulipes* Signoret
- gibbosa* Spinola
- orientalis orientalis* Dolling
- orientalis serica* Dolling
- curvipes* (Stål) comb. n.
- simillima* sp. n.
- wittei* (Schouteden) comb. n.
- neavei* sp. n.
- alpica* (Bergróth) comb. n.
- montana* sp. n.

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By W. R. Dolling.

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A review of the genera of the Hydroptilidae (Trichoptera).
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Bulletin of the British Museum (Natural History)

A revisionary classification of the
Cynipoidea (Hymenoptera) of the
Ethiopian Zoogeographical Region

Aspicerinae (Figitidae) and Oberthuerellinae
(Liopteridae)

J. Quinlan

The *Bulletin of the British Museum (Natural History)*, instituted in 1949, is issued in four scientific series, Botany, Entomology, Geology (incorporating Mineralogy) and Zoology, and an Historical series.

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A revisionary classification of the Cynipoidea (Hymenoptera) of the Ethiopian Zoogeographical Region

Aspicerinae (Figitidae) and Oberthuerellinae (Liopteridae)

J. Quinlan

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Synopsis

This is the first of a series of papers which will cover the taxonomy of the cynipoid fauna of the Ethiopian Region. Keys to the world families and subfamilies are provided. In addition, keys to the genera and species of the Ethiopian Aspicerinae and Oberthuerellinae are given and are based on a study of type-specimens and all other available material. Twelve new species are described, and five new combinations and two new specific synonymies are established.

Introduction

This is the first attempt to review the Ethiopian Cynipoidea as a whole. Except where specific exceptions are mentioned the term Ethiopian Region refers to the original concepts of Sclater

(1858) and Wallace (1876). The most recent work covering the Cynipoidea at the family, subfamily and generic level is that of Weld (1952); this work dealt with the fauna of all geographical regions and superseded that of Dalla Torre & Kieffer (1910), which was the first comprehensive treatise on the Cynipoidea. More recently Benoit (1952–56) described various genera and species from Africa but did not include generic keys. All known species of which type-material is available have been fully redescribed. Where the type-material is lost its presumed taxonomic position is indicated in the text. In very few instances are host data given, and these are based solely on labels attached to the specimens.

Material examined, terminology and acknowledgements

I have been fortunate in being able to borrow large amounts of material from Dr J. Decelle, Musée Royal de l'Afrique Centrale, Tervuren; Madame S. Kerner-Pillault, Muséum National d'Histoire Naturelle, Paris; Dr E. Königsman, Museum für Naturkunde der Humboldt-Universität, Berlin. All have been kind enough also to loan type-material from their respective collections. This material, together with R. E. Turner's cynipoid collections in the British Museum (Natural History) and more recent material obtained from Malaise traps, has formed the basis for this revision. There are, however, large areas in the Ethiopian Region from which no material has been available for examination. The terminology used is as in Richards (1977), but some older names are used particularly in reference to wing venation. Some of the more general taxonomic terms used in this paper are illustrated by labelled figures (Figs 1–21). It is hoped that this will provide a correlation between the terms used by Richards (1977) and by Ross (1936). Type depositories are given in abbreviated form in the text and are listed below in alphabetical order of the towns in which they are situated.

MNHU, Berlin	Museum für Naturkunde der Humboldt-Universität, Berlin
IP, Eberswalde	Institut für Pflanzenschutzforschung, Eberswalde, Germany
AM, Grahamstown	Albany Museum, Grahamstown, South Africa
KSM, Kansas	Snow Entomological Museum, University of Kansas, Lawrence, Kansas
BMNH	British Museum (Natural History), London
MNHN, Paris	Muséum National d'Histoire Naturelle, Paris
MRAC, Tervuren	Musée Royale de l'Afrique Centrale, Tervuren, Belgium

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Family classification of Cynipoidea

In preparing the key to families account has been taken of subfamilies proposed since Weld (1952). Five families and thirteen subfamilies are recognised in this paper. Yoshimoto (1970) proposed the name *Himalocynipinae* to include the genus *Himalocynips*. According to Yoshimoto this new subfamily is distinguished from *Figitinae* on the number of antennal segments, a partial nervulus and post nervulus in the forewing, and a projecting clypeus. I have not seen the unique specimen on which the subfamily is based but have included it in the key to subfamilies on the basis of the description. Similarly, to accommodate the genus *Austrocynips* Riek (1971) erected the subfamily *Austrocynipinae* which, because it has a strongly produced hypopygium, he associated with the subfamily *Cynipinae*. The wing venation, however, appears to be closer to that of the *Pycnostigmatinae*, which have a radial cell resembling at first sight a pterostigma.

In the family and subfamily keys the *Eucoilidae* have been treated as a family and not as a subfamily of the *Figitidae* as in Weld (1952) and earlier authors. The reason for this is stated by Eady & Quinlan (1963), namely that the differences between *Eucoilidae* and subfamilies *Anacharitinae*, *Figitinae* and *Aspicerinae* are much greater than the differences between these three subfamilies of *Figitidae*.

The Ibalidae are distinguished from all other families by the elongate radial cell (Fig. 9), distinct areolet, smooth and inconspicuous petiole and elongate metatarsus (Fig. 10). As far as is known all species are parasites of Siricidae (Symphyta). They are probably the largest cynipoids, being between 10 and 25 mm in length. Their distribution is Holarctic and Australasian.

The Liopteridae are distinguished from the Ibalidae by the short radial cell and from other families by the relative lengths of the gastral segments. The Liopteridae are large, 5–14 mm in length. The family consists of three subfamilies, mainly tropical in distribution, of which two (Oberthuerellinae and Mesocynipinae) are known to occur in the Ethiopian Region. The life history is not known.

The Eucilidae are parasites of Diptera, and are clearly distinguished from other Cynipoidea by their distinctive scutellum, which comprises an outer disc surmounted by a cup-shaped elevation in the centre (Fig. 14). The pronotum is very often distinctly produced medially into an anterior plate with a strong posterior margin (pronotal plate). In the forewing the cubitalis ($Rs+M$) is usually visible and emerges from a point very close to the lower end of the basalis (close to the junction of $M+Cu$) or combined with the median (Cu_1) for a short distance (Fig. 15). The life histories of some of the more common species are known; they are of economic importance in that they parasitise Diptera attacking cereal crops. Eucilidae have a wide range of dipterous hosts including the stem-boring and leaf-mining larvae of the family Agromyzidae, the plant-feeding families Chloropidae and Anthomyiidae and those larvae of the family Sphaeroceridae and other flies associated with animal excreta. Adult Eucilidae vary in size from 1.5 to 5.0 mm and are world-wide in distribution.

The Figitidae include four subfamilies, each resembling the others in the majority of characters. The Aspicerinae are generally the largest, 4.5–5.0 mm in length, and are parasites of the larger Diptera such as Syrphidae. The gaster has a very distinctive second tergite which is shaped rather like a saddle and termed liguliform (Fig. 5). The Anacharitinae have wedge-shaped heads and generally the second tergite of the gaster is longer than the third (Fig. 8). The forewing has at the most a vestigial cubitus (vein M) and a distinctive radial cell (Fig. 21). The adults vary in size from 3 to 4 mm depending on the length of the petiole. Some genera have a short petiole and can be confused with the subfamily Figitinae. The Anacharitinae are parasites of lace-wings (Neuroptera). The Figitinae are very similar to the Anacharitinae and Aspicerinae, but in the majority of genera the second tergite is shorter than the third or equal to it and generally the cubitus (vein M) is distinct, thus separating it from the Anacharitinae. They are parasites of smaller Diptera and range in size from 2 to 4 mm. They are world-wide in distribution. However, all three subfamilies have genera that can be confused with those of other subfamilies, e.g. in Figitinae the genera *Neralsia* Cameron and *Xylophora* Kieffer have a very reduced second gastral tergite which can be mistaken for that of an Aspicerinae, and in some cases the cubitus is vestigial as in the Anacharitinae.

The subfamily Himalocynipinae is similar to the Figitinae (Yoshimoto, 1970) but differs in having 20-segmented antennae, the head unusually small in relation to the thorax, the second tergite of the gaster considerably longer than the third, a partial nervulus and postnervulus present in the forewing, and a small subcordate clypeus strongly projecting forward and upward. Size 5.5 mm.

The family Cynipidae is represented by three subfamilies, each having distinctive characters, but some genera are nevertheless difficult to place in a subfamily. Cynipidae are separated from related families on the forewing venation and the relative lengths of the gastral segments. In the forewing the cubitalis ($Rs+M$), when visible, arises from a point midway along the basalis ($Rs+M$) (Fig. 17) and in the female the largest free tergite is either the second or the second and third fused (Figs 18–19). The Pycnostigmatinae contains two genera; as far as is known both are restricted to Africa. The forewing is very distinctive in having a reduced radial cell which, unless closely examined, can be mistaken for a pterostigma, the wing veins are very thick (Fig. 23), and the number of antennal segments is 12, 15 or 19. When viewed laterally, the gaster has what appears to be one large segment occupying almost the whole of the visible surface area; this consists of segments two and three fused together, the remaining segments generally being obscured. The first segment of the gaster in one genus is longitudinally ridged as in the cynipine

genus *Synergus* Hartig. This appearance of the gaster has been taken by some authors as suggesting the habitus of an inquiline. At present its life history is unknown. Size 2.5–4.0 mm.

The Cynipinae are usually sculptured and the middle and hind tibiae each have two distal spurs. They are either gall-causers or inquilines in galls of other Cynipinae. The gall-causers attack a range of plants: Compositae, Labiatae, Papaveraceae, etc. (herbaceous plants); Rosaceae; Fagaceae (*Quercus*). The only gall-causer at present known from the Ethiopian Region is *Rhoophilus* Mayr on *Rhus* (Anacardiaceae). In the extreme northern parts of Africa where there are oaks various European genera (*Andricus*, *Neuroterus*, etc.) are found. Some species of Cynipinae on oak exhibit the phenomenon of alternation of generations. One generation consisting of both males and females and the other entirely of agamic females reproducing parthenogenetically. One genus, *Ceroptres*, has been bred commonly from galls on oak; Blair (1949), however, stated that *C. arator* Hartig was parasitic on *Andricus kollari* (Hartig). Riek (1971) refers to *Ceroptres* as being an inquiline in dipterous galls. The size varies from 2 to 7 mm.

The Alloxystinae are very small in relation to other Cynipoidea, the larger specimens being only about 2 mm long, and are separated from other Cynipidae by the characteristic shiny appearance although sculpture is revealed by the scanning electron microscope, see Andrews (1978). The whole insect lacks the rugose type of sculpture found on the mesonotum of Cynipinae, and the scutellum only rarely has distinct foveae; occasionally notaulices are present and in others a mesopleural suture is present. They are hyper-parasites of aphids through the braconid subfamily Aphidiinae. Distribution is world-wide.

Taxonomic characters of Cynipoidea

Antennae

The antennae of the ♀ are generally 13-segmented and vary in length and shape but are constant within a species. Some species have filiform antenna and others are club-shaped. The ♂ antennae are usually 14-segmented and filiform. However, in certain genera the number of segments can vary by the occasional extra segments and in one or two subfamilies by up to a maximum of 7 extra segments in the ♀. The antenna consists of a scape, pedicel and flagellum (Fig. 28). In describing the females of some species the term club is used and in this paper, in order that a club segment is not confused with other segments, I have counted as club segments those with rhinaria. The relative lengths of antennal segments are given as ratios, e.g. Segment Numbers (SN) 1, 2, 3, 4 = Antennal Ratio (AR) 5 : 3 : 18 : 12, to further explain the overall shape of the antennae. In some males some of the basal segments of the flagellum are modified, i.e. swollen or excised (Figs 38–40).

Head

Characters most useful are the distance between the compound eyes (inner orbits) compared with the height of an eye measured medially. The variation in the shape of the vertex viewed posteriorly and in some subfamilies the shape of the occipital carina and sculpture in the occipital area are important. Some species have heads broader than the thorax. In general, however, head characters have not been used at the family and subfamily level but within genera and species a wide variety of different parts have been used. In some groups the form of mandible varies and probably relates to the biology of particular groups and their various methods of emerging when adult, be their habitat as larvae a gall or an insect. The sculpture of the face, the presence or absence of striae and of pubescence are usually important at the specific level.

Thorax

The thorax has many important characters (Fig. 29). As in Apocrita generally the first abdominal segment has become fused with the thorax and is connected to the abdomen by a narrow petiole. This post-propodeal part of the abdomen is termed the gaster (Figs 1–8). In some families the pronotum has a distinctive medial protrusion (pronotal plate) which varies in shape and this is a useful character at the generic and species level (Figs 13, 22, 30). This is best seen in anterodorsal view. In certain species the pronotal plate is either absent or represented by small pits or foveae.

The mesoscutum can have notaulices (parapsidal grooves) which vary in length, width and surface sculpture. Anterior parallel lines, lateral lines and a median scutal line are present in some species, absent in others. The mesopleuron sometimes has a mesopleural suture (precoxal suture or carina of Richards, 1977; median episternal groove of Snodgrass, 1910). This suture, when present, can be very distinct or lost in a mass of striations or reticulate-rugose sculpture. Its form within a species is fairly constant and therefore a useful character either at the species level or at the generic level in some families. An area present in some genera in the upper anterior part of the mesopleurae and more recently termed mesopleural triangle (Andrews, 1978) is useful at the generic level. In the majority of genera the scutellum has either one or two pits or foveae at the base bordering the suture separating the mesoscutum from the scutellum, although in some genera, e.g. *Neuroterus*, the mesoscutum is fused to the scutellum without a suture. In Eucoilidae some genera have a distinctive lateral bar on either side of the foveae. The scutellum is usually separated from the mesoscutum by a suture and varies enormously between families, being smooth and shiny in the Alloxystinae, coarsely sculptured in the Figitinae and Aspicerinae or with a distinctive disc or cup in the Eucoilidae. The term cup used by Weld (1952) is employed here to differentiate that centre part of the scutellum from the outer part termed the disc. The disc itself has dorsal and lateral faces in some families (Fig. 29). In some genera of Aspicerinae, Figitinae and Eucoilidae the apex of the scutellum is produced to form a very distinct spine. The propodeum generally has parallel or bowed carinae which are sometimes obscured by pubescence.

Gaster

The gaster is extremely variable in the relative lengths of the segments and in their shape viewed laterally and dorsally. In a number of instances there has been fusing together of segments. The first segment of the gaster is petiolate, either long or short, smooth or sulcate and sometimes hidden by a ring of pubescence at the base of tergite 2 in the Eucoilidae. The surface of tergite 2 at the base is sometimes striated and other segments can be punctate. The hypopygium is very clearly produced in the Cynipinae, the ventral spine varying in length.

Legs

The legs vary in size and the shape of the various parts, and can be densely pubescent on the coxae in some species. In some genera the hind tibiae are longitudinally rigid or furrowed, in others the hind femur has a tooth. The mid and hind tibial spurs can vary in length. In the Cynipidae the hind tarsal claws provide useful generic and specific characters. In the Ibalidiidae the metatarsus is exceptionally long, being twice as long as tarsal segments 2-5 combined.

Wings

Cynipoidea generally are fully winged although some families have brachypterous or apterous forms. The venation of the forewing, though somewhat reduced, generally retains two branches of vein *Rs* (Fig. 15). The presence of vein *Rs+M* and the point of juncture with *Rs+M* and its closeness to *Cu₁* are important at the subfamily level in those groups where it is present. The radial cell varies significantly in shape within families and from species to species, being either open or closed on the wing margin. The presence or absence of the areolet and cubitus is important in all groups. Generally the wing surface has fine scattered pubescence, although in some species this character is completely absent or reduced to a dotted surface and is invariably ciliate on the wing margins. In some species the apex of the forewing can be arcuate, incised or truncate though generally it is rounded.

Sculpture

Cynipoidea exhibit extremes of sculpture, both in form and intensity, on various parts of the insect. Only the Alloxystinae appear completely devoid of sculpture (visible under scanning electron microscope). In other subfamilies, e.g. Liopteridae, the mesonotum has a coarse transversely sculptured surface. In the Figitidae the sculpture of the mesonotum varies in form from dull and sculptured to smooth and shining. The Cynipinae gall-causing genera with alternate generations exhibit extreme diversity. In the agamic forms the face, mesoscutum, scutellum and

mesopleurae have different types of sculpture and some are pubescent. In the sexual forms the various parts can be alutaceous or finely coriaceous. The terminology for sculpture follows Eady (1968).

Colour

Most Cynipoidea are sombre in colour. They are more generally a mixture of black, red or yellow but never metallic as in some other Hymenoptera. In the larger species the thorax tends to be blackish with a distinctive reddish brown gaster, e.g., *Liopteridae*, *Ibaliidae*. In the smaller species a mixture of red, black and yellow is normal, and exceptionally in the agamic forms of some Cynipidae, a dull darkish yellow. Some species are predominantly blackish, in other species reddish blackish yellowish colour patterns are exhibited. The use of colour in identification has to be treated cautiously because, as with other Hymenoptera, factors such as humidity, temperature, host or plant habitat of the larval stages can have a strong influence on the colour of the adult insect.

Key to families and subfamilies of world Cynipoidea

- 1 Largest segment of the gaster the fourth, fifth or sixth viewed laterally (Figs 1–4) with two to four small segments preceding largest segment 2
- Largest segment of the gaster the second or third (Figs 5–8), or formed by these two segments fused together (Fig. 7), with at most only one small segment preceding the largest 5
- 2 Radial cell of forewing at least nine times as long as broad, closed on front margin (Fig. 9). Segment 2 of gaster longer than 3 viewed laterally along the dorsal curvature, segment 1 smooth and indistinct, segment 6 the largest. Segment 1 of tarsus (metatarsus) of hind leg as long as segments 2–5 combined (Fig. 10) **IBALIIDAE**
- Radial cell of forewing less than nine times as long as broad. Segment 1 of hind tarsus not as long as 2–5 combined. Petiole distinct and sulcate (except the genera *Kiefferiella* and *Heteribalia*) (**LIOPTERIDAE**) 3
- 3 Hind femur with a distinct tooth on underside (Fig. 11) between middle and apex. Mid and hind coxae almost round and strongly swollen. Scutellum with a distinct spine at apex (Fig. 12) (exceptionally without). Segment 1 of gaster generally at least as long as wide, sulcate, segment 5 the largest with three short segments preceding it (except in *Xenocynips* which has 2–4 fused) (Fig. 32) **OBERTHUERELLINAE** (p. 109)
- Hind femur without a tooth on the underside, mid and hind coxae elongated. Scutellum without a spine. Segment 1 of gaster sometimes shorter than wide 4
- 4 Segment 1 of gaster at least twice as long as wide and attached tangentially (Fig. 3); segment 4 of gaster the largest **LIOPTERINAE**
- Segment 1 of gaster in the form of a ring or collar, never longer than wide and attached normally (Fig. 4); segment 5 or 6 of gaster in ♀ (except in *Paraegilips*, a genus based on a ♂ from the Philippines) the largest **MESOCYNIPINAE**
- 5 Scutellum with a disc or cup on dorsal surface (Fig. 14). Pronotum often very pronounced, produced frontodorsally into an anterior plate with a strong posterior margin (pronotal plate) (Fig. 13). Forewing with cubitalis ($Rs+M$) usually visible and arising from a point very close to lower end of the basalis (near junction with $M+Cu$) (Fig. 15), areolet not indicated, or combined with median (Cu_1) for a short distance. Segments 2 and 3 of gaster fused, without visible suture. (Brachypterous forms sometimes occur.) **EUCOILIDAE**
- Scutellum without a disc or cup dorsally, sometimes with a posterior fovea or apical spine (Fig. 33) (Aspicerinae). Pronotum if raised dorsally into an anterior plate then without a posterior margin, very often indistinct or absent 6
- 6 Alate; forewing with cubitalis ($Rs+M$), when visible, arising from a point at or close to junction of basalis (Rs or Rs and M) with median (Cu_1) (Fig. 16), areolet indicated. Female often with either second or third tergite of gaster the largest (Fig. 6). Male generally with cylindrical gaster (except Aspicerinae). Mesopleuron sculptured medially at least, or scutellum with apical spine (**FIGITIDAE**) 7
- Winged, brachypterous or apterous. Forewing with cubitalis ($Rs+M$), when visible, arising from a point nearer the middle of basalis (Rs and M) than to the junction of basalis with median (Cu_1) (Fig. 17). Female with the largest free tergite either the second (Fig. 19) or the second and third fused together, with or without an obsolete suture visible (Fig. 18). Both sexes

- with gaster laterally compressed; sometimes whole insect smooth and shining. Scutellum never with an apical spine (**CYNIPIDAE**) 10
- 7 Tergite 2 of gaster liguliform (Fig. 5). Hind tibiae in most genera longitudinally ridged or furrowed on outer margins or posteriorly (Fig. 34). Scutellum with one or more longitudinal carinae and subapically with either a spine or foveae. Thorax sculptured **ASPICERINAE** (p. 93)
- Tergite 2 of gaster not liguliform (Fig. 6). Hind tibiae not longitudinally ridged or furrowed externally or posteriorly, at most with longitudinal carinae or groove internally. Scutellum usually without three longitudinal carinae or subapical fovea, though more frequently produced apically to form a spine. Thorax generally smooth and shining, occasionally dull and sculptured 8
- 8 Tergite 2 of gaster shorter than third (Fig. 6); segment 1 never as long as wide. Forewing with cubitalis ($Rs+M$) dividing externally before point of emission of $2rm$ (i.e. areolet present, though often obsolete) (Fig. 16) **FIGITINAE**
- Tergite 2 of gaster longer than third (Fig. 8), segment 1 at least as long as wide, generally more than twice as long as wide (Fig. 8). Forewing with cubitalis ($Rs+M$) dividing externally at point of emission of vein $2rm$ (i.e. areolet vestigial) (Figs 20, 21) 9
- 9 Head distinctly broader than thorax viewed dorsally. Gaster wedge-shaped (except in *Acanthae-gilips*). Antenna of ♀ 13-segmented, ♂ 14-segmented. Radial cell of forewing open or closed, cubitus vestigial, nervellus and post nervellus absent. Segment 1 of gaster at least as long as broad, generally much longer and petiolate; tergite 2 of gaster longer than third (Fig. 8) **ANACHARITINAE**
- Head small, narrower than thorax, oblong in dorsal view. Antenna of ♀ 20-segmented (♂ unknown). Radial cell of forewing open on front margin (R_1 and Rs_2 not reaching margin of wing), cubitus (M) almost reaching apex of forewing, areolet absent, nervellus (Cu and $Cu-a$) and post nervellus ($M-cu$) indicated. Clypeus projecting forward and upward away from the unsclerotized area and truncate labium. Segment 1 of gaster shorter than wide, tergite 2 at least half as long as remaining visible segments viewed laterally **HIMALOCYNIPINAE**
- 10 Radial cell of forewing with a distinct pterostigma (Fig. 20).
Antennae of ♀ 15-segmented, ♂ unknown **AUSTROCYNIPINAE**
- Forewing without a true pterostigma 11
- 11 Radial cell much reduced, closed, its veins thick and heavy (Fig. 23).
Gaster with segments 2 and 3 completely fused (as in *Synergus*, cf. Fig. 18). Antennae of ♀ 12-, 15- or 19-segmented. **PYCNOSTIGMATINAE**
- Radial cell normal (at most very little reduced), open or closed (Figs 17, 35) (apterous forms occur) 12
- 12 Mid-tibia often with only one spur, hind tibia with one spur or more often with two very unequal spurs. Vertex, mesoscutum, scutellum, mesopleuron and gaster smooth and shiny. Pronotum generally sharply angled anteriorly (Fig. 24), this forming a lateral vertical carina (Fig. 25). Gaster with a pubescent ring at base of tergite 2. Male antenna with either the fourth, rarely the third, sometimes the third to fifth segment modified (Figs 39, 40) **ALLOXYSTINAE**
- Mid and hind tibiae each with two distinct spurs. Sculpture present at least on the vertex, mesoscutum, scutellum, mesopleuron or gaster. Pronotum generally not angled sharply anteriorly (Figs 26, 27), but if some carinae indicated (Figs 36, 37) then head and thorax strongly sculptured. Gaster very rarely with pubescence at base of tergite 2 of gaster. Antenna of male with modified segment, when present, always the third (Fig. 38) **CYNIPINAE**

Checklist of the families and subfamilies of Cynipoidea

- IBALIIDAE** Thomson, 1862
LIOPTERIDAE Ashmead, 1895
 OBERTHUERELLINAE Kieffer, 1903
LIOPTERINAE Ashmead, 1895
 MESOCYNIPINAE Hedicke & Kerrich, 1940
EUCOILIDAE Thomson, 1862
FIGITIDAE Thomson, 1862
 ASPICERINAE Kieffer, 1910
 FIGITINAE Thomson, 1862

- ANACHARITINAE Thomson, 1862
 HIMALOCYNIPINAE Yoshimoto, 1970
 CYNIPIDAE Hartig, 1840
 AUSTROCYNIPINAE Riek, 1971
 PYCNOSTIGMATINAE Cameron, 1905
 ALLOXYSTINAE Hellén, 1931
 CYNIPINAE Hartig, 1840

Checklist of the Ethiopian species of Aspicerinae and Oberthuerellinae

- FIGITIDAE Thomson, 1862
 ASPICERINAE Kieffer, 1910
ANACHAROIDES Cameron, 1904
arcus sp. n.
astrida sp. n.
decellius sp. n.
elongaticornis Benoit, 1956
eurytergis Benoit, 1956
nigra sp. n.
pallida sp. n.
paragi Benoit, 1956
quadrus sp. n.
rufa (Kieffer, 1910)
sanitus sp. n.
striaticeps Cameron, 1904
spinosipes (Kieffer, 1910)
gibbosus Benoit, 1956 syn. n.
stygius Benoit, 1956
suspensus sp. n.
PROSASPICERA Kieffer, 1907
africana (Kinsey, 1919) comb. n.
antennata (Benoit, 1956) comb. n.
kisantua (Benoit, 1956) comb. n.
optivus sp. n.
paragicida (Benoit, 1956) comb. n.
tropica (Kieffer, 1910) comb. n.
 LIOPTERIDAE Ashmead, 1895
 OBERTHUERELLINAE Kieffer, 1903
OBERTHUERELLA Saussure, 1890
abscinda sp. n.
aureopilosa Benoit, 1955
breviscutellaris Benoit, 1955
crassicornis Benoit, 1955
compressa Benoit, 1955 syn. n.
lenticularis Saussure, 1890
longicaudata Benoit, 1955
longispinosa Benoit, 1955
nigra Kieffer, 1910
nigrescens Benoit, 1955
tibialis Kieffer, 1904
triformis sp. n.
TESSMANNELLA Hedicke, 1912
expansa sp. n.
nigra Hedicke, 1912
spinosa Hedicke, 1912
transiens Benoit, 1955
 XENOCYNIPS Kieffer, 1910
subsquamata Kieffer, 1910

ASPICERINAE Kieffer

Aspicerinae Kieffer, 1910 : 50. Type-genus: *Aspicera* Dahlbom.

Tergite 2 of gaster less than half the total length of gaster and distinctly liguliform (Fig. 5). Hind tibia in most genera with a longitudinal ridge. Scutellum with one or more longitudinal carinae and subapically with a tooth or spine. Forewing with radial cell completely open on front margin (Fig. 45), invariably open at base; wing surface generally bare, margins either bare or with short hair fringe.

DISCUSSION. Eight genera are at present recognised as being in the subfamily Aspicerinae. Only two of these, *Prosaspicera* Kieffer and *Anacharoides* Cameron, are known to occur in the Ethiopian Region. Previously four species of *Aspicera* Dahlbom were recognised; these are now transferred to *Prosaspicera*. Two other species of *Aspicera* have been described from North Africa and do not occur in the region covered by this paper. They are *A. aegyptica* Hedicke from Egypt and *A. lobata* Hedicke from Tunisia. The holotypes of these two species were lost due to bombing in the 1939–45 war. *Aspicera* has been included in the key to genera in order that it may be recognised if it is found to extend into the Ethiopian Region. Of the genera now recognised from the region, *Prosaspicera* contains, together with the one new species described here, six species. Of these, five are based on females, and one on a male; in only two species are males and females correlated. The genus *Anacharoides* now contains 13 recognised species of which seven are known from both males and females; six of these species are new and described here for the first time. Two Kieffer species, *spinosipes* and *rufa*, both originally described in the genus *Coelonychia*, are lost and could not be found by Dr Königsman. In correspondence he indicated that they might be in another collection of which loan records have been lost. *C. spinosipes* was made a junior synonym of *Anacharoides striaticeps* Cameron by Weld (1930).

The Aspicerinae have many close affinities with the Figitinae but are generally distinguished from them on the shape of tergite 2 of the gaster, which is liguliform or saddle-shaped (Fig. 5), and the longitudinally ridged or furrowed hind tibiae. The thorax is invariably sculptured and the scutellum has one or more longitudinal carinae and subapically a spine or foveae.

Key to genera of Ethiopian Aspicerinae

- 1 Scutellum with a sharply pointed apex in the form of a spine, not rounded, truncate or emarginate; scutellar foveae not extending to middle of scutellum (Fig. 33). Scutellar spine with longitudinal striations; mesonotum sculptured, rarely shining. Segment 1 of gaster wider than long and crenulate. Radial cell of forewing open at base, generally with R_1 indicated (Figs 41, 42). Hind tibiae with hairs but without erect spines (Fig. 43) 2
 - Scutellum not ending in a spine, truncated at apex (Fig. 44); scutellar foveae extending at least half the length of scutellum, separated by a septum, the apex of each fovea enclosing a triangular area; apex of scutellum with a margined semicircular depression (Fig. 44). Segment 1 of gaster at least twice as long as broad. Radial cell of forewing completely open at base (Fig. 45). Hind tibiae with perpendicular spines on outer margin (Fig. 46)
- ANACHAROIDES** Cameron (p. 94)
- 2 Mesoscutum dull and conspicuously reticulate-coriaceous with medial scutal line in form of a raised ridge starting at base, dividing at a point two-thirds down from the apical margin of the pronotum and forming a depressed area at its apex (Fig. 47); anterior parallel lines ridged, visible in basal third of mesoscutum; notaulices wide at apex, tapering at base, distinct and crenulate; lateral lines indicated at apex of mesoscutum, scutellum with two foveae at base separated by a septum, lateral margins of scutellum reticulate-coriaceous; scutellar spine broad-based, arising from a point near middle of truncate scutellum, measured from apex of scutellum subequal to length of mesoscutum and tapering to a sharp point (Fig. 47); spine viewed laterally curved upward. Vertex generally incised (Fig. 48) **PROSASPICERA** Kieffer (p. 104)
 - Mesoscutum shiny with fine reticulate sculpture between strong widely spaced transverse strigose sculpture; median scutal line and parallel lines continued from base of scutellum to centre of mesoscutum, median scutal line forming a triangular area at apex; notaulices wide, distinct and crenulate, lateral lines indicated as ridges. Scutellar foveae separated by a septum; lateral margins of scutellum strigose, apex of scutellum truncated, spine arising at a

- elongate, shiny reticulate. Apical segment of antennae dark, remainder orange-yellow. R_1 of forewing weakly indicated (Fig. 69) *sanitas* sp. n. (p. 102)
- Mesoscutum finely reticulate, notaulices crenulate, complete, whole surface of mesoscutum covered with hairs obscuring notaulices, median scutal line complete, obscured by pubescence; apical depression of scutellum angular at apex; scutellar foveae round, smooth and polished. Apical segment of antennae variable in colour, remaining segments orange-yellow. R_1 of forewing not indicated *quadrus* sp. n. (p. 101)
- 7 Mesoscutum with widely spaced strong irregular transverse rugae medially on finely reticulate surface; notaulices with crenulations, median scutal line extending at least to the middle of the mesoscutum (Fig. 63).
Antennae yellow or yellow with the apical segments dark yellow 8
- Mesoscutum finely reticulate-coriaceous, at most with weak transverse rugae on outer margins of notaulices; median area finely reticulate, notaulices either distinct or in the form of widely spaced crenulations, median scutal line either complete or not reaching past middle of mesoscutum 9
- 8 Mesoscutum at most with fine scattered pubescence, surface finely reticulate-coriaceous between widely spaced transverse rugae, notaulices with widely spaced crenulations, pubescence sparse, not obscuring sculpture, anterior parallel lines converging to join at median scutal line (Fig. 63), apex of median scutal line in form of a small triangular polished area apically, fading out before reaching middle of mesoscutum. $Sc+R$ of forewing weakly angled at point where R_1 would emanate if present, Rs_2 strongly curved, weakly extended along the wing margin, $2rm$ short and broad (Fig. 86) *striaticeps* Cameron (p. 103)
- Mesoscutum with long scattered pubescence, its surface reticulate-coriaceous between strong transverse rugae; notaulices wide with close crenulations but obscured by scattered pubescence, anterior parallel lines obscured by whitish pubescence, median scutal line obscured by long hairs, not distinctly widened at apex, merging into the transverse rugae of mesoscutum. Radial cell of forewing with $Sc+R$ angled at point close to where R_1 would emanate, Rs_2 weakly curved, strongly extended along wing margin, $2rm$ long and narrow (Fig. 70) *arcus* sp. n. (p. 96)
- 9 Forewing with Rs_2 not reaching wing margin, extended weakly below margin (Fig. 71). Median scutal line distinct. Head, mesoscutum and mesopleurae either completely black or reddish orange 10
- Forewing with Rs_2 reaching wing margin, not extended along margin (Fig. 72). Median scutal line obsolete, at most with weak triangular area at apex. Head and mesoscutum never completely black, variably red- to black-marked 11
- 10 Median scutal line complete with a triangular depression at apex, deeply impressed, extending to middle of mesoscutum (Fig. 75). Head, mesonotum and mesopleurae completely black, gaster bright yellow *nigra* sp. n. (p. 117)
- Median scutal line incomplete with a small triangular shallow depression at apex not extending to middle of mesoscutum (Fig. 76). Head, mesonotum and mesopleurae reddish orange to brownish, gaster chestnut-brown *decellius* sp. n. (p. 97)
- 11 Mesoscutum finely reticulate-coriaceous with weak transverse rugae on inner margins basally, median area without pubescence, median scutal line obsolete in basal half, triangular area at base distinct, extending to a point midway on mesoscutum (Fig. 77), notaulices complete, distinct with close shallow crenulations; scutellar foveae deep basally, polished. Colour orange-yellow *pallida* sp. n. (p. 100)
- Mesoscutum densely pubescent on a fine reticulate-coriaceous surface, notaulices with widely spaced crenulations obscured by pubescence, median scutal line obsolete basally, visible in apical quarter, triangular area at apex weak and obscure (Fig. 73); scutellar foveae shallow. Viewed dorsally, head orange-yellow, mesoscutum dark brown except apex orange-yellow, scutellum orange-yellow, gaster chestnut-brown *eurytergis* Benoit (p. 100)

Males (unknown in *elongaticornis*, *nigra*, *pallida*, *paragi* and *stygius*)

- 1 Segment 3 of antenna weakly expanded apically, slightly curved, never with flattened surface on basal half (Fig. 78) 2
- Segment 3 of antenna generally strongly expanded apically and medially, always with basal half distinctly narrower than apex and flattened (Fig. 79) 3
- 2 Segments 4–14 of antenna moniliform, not swollen distally; notaulices distinct and crenulate, anterior parallel lines converging to join median scutal line; apical depression of scutellum

- without triangular-shaped area at base; median scutal line with obsolete horseshoe-shaped area at apex, mesoscutum reticulate-coriaceous with scattered pubescence *quadrus* sp. n. (p. 101)
- Segments 4-6 of antenna weakly swollen distally (Fig. 80); notaulices weakly crenulate, apical depression of scutellum viewed dorsally with pronounced triangular-shaped area at base, median scutal line strongly raised, the apical area in form of acute triangular shape extending to middle of mesoscutum, mesoscutum reticulate with scattered pubescence on outer margins of notaulices *arcus* sp. n. (p. 96)
 - 3 Segment 3 of antenna strongly expanded on outer apical margins, segments 4-14 moniliform or only very weakly expanded medially (Figs 79, 84) 4
 - Segments 3 and 4 of antenna swollen or expanded apically on outer margins, base of segments clearly narrower than apex (Fig. 81) 5
 - 4 Mesoscutum with closely spaced strong transverse rugae between notaulices, median scutal line triangular at apex and transversely striated (Fig. 82), notaulices distinct, not obscured by the fine pubescence. Head and thorax predominantly red-reddish brown, hind coxae strongly swollen (Fig. 83) *suspensus* sp. n. (p. 104)
 - Mesoscutum without transverse rugae, surface fine reticulate-coriaceous, notaulices distinct but obscured by fine scattered pubescence. Head and thorax completely black, hind coxae long and narrow (Fig. 85) *decellius* sp. n. (p. 97)
 - 5 Segments 3 and 4 of antenna swollen at apex, 5-14 moniliform (Fig. 87) *striaticeps* Cameron (p. 103)
 - Segments 3-5 of antenna swollen on outer margins (Fig. 88) 6
 - 6 Segments 3-5 of antenna distinctly swollen on outer margins apically, 6-14 moniliform, notaulices distinct, without crenulations, mesonotum finely reticulate-coriaceous. Head black suffused with red, thorax reddish black *sanitas* sp. n. (p. 102)
 - Segments 3-6 of antenna swollen apically. Head and thorax completely black 7
 - 7 Segments 3-6 of antenna distinctly swollen apically, 7-14 moniliform (Fig. 91). Mesoscutum fine reticulate-coriaceous with closely spaced broken rugae medially, not pronounced *eurytergis* Benoit (p. 99)
 - Segments 3-7 of antenna distinctly swollen apically (Fig. 90), segment 8 very weakly swollen, 9-14 moniliform. Mesoscutum fine reticulate-coriaceous with widely spaced transverse rugae, notaulices deeply crenulate *astrida* sp. n. (p. 97)

Anacharoides arcus sp. n.

(Figs 44, 70, 80)

DESCRIPTION. ♀. Antenna 13-segmented, segment 3 longer than apical segment, shorter than 4 and 5. SN 3-13=AR 50:28:28:25:25:20:20:20:20:20:45. ♂ antenna 14-segmented, segment 3 subequal in length to 4 plus 5, 3 weakly curved on outer margin, 4, 5 and 6 expanded apically (Fig. 80). Head viewed frontally with eyes closer together than height of eye measured midway between eyes, vertex incised, frontal carinae distinct, face reticulate-rugose, pubescent on the inner orbits, occiput strongly striated, strigose between lateral ocellus, vertex incised, pronotum viewed dorsally angled on the basal side margins, mesoscutum with reticulate surface sculpture and transverse rugae, anterior parallel lines aberrant, obscured by pubescence, notaulices in form of weak crenulate suture, complete, median scutal line indistinct basally, ending in weak triangular area apically, obscured by the surface sculpture of mesoscutum, scutellar fovea extending half the length of scutellum, finely sculptured, the apex of each fovea triangular, separated by a septum, apical depression of scutellum, arcuate with strong raised margins, lateral bars of scutellum reticulate. Mesopleural carinae distinct, the surface below carinae sculptured and pubescent, carinae of propodeum bowed. Segment 1 of gaster petiolate, sulcate, three times as long as broad, segment 2 of gaster liguliform, segment 3 the largest, closely punctate on apical half in dorsal and lateral views, propodeum and coxae strongly pubescent. Hind tibia with longitudinal furrow and suberect spines on outer margin viewed dorsally. Colour: ♀ antenna dark yellow, apical segments dark, legs brownish yellow, head brownish orange, pronotum reddish orange on front margin; mesopleura dark brownish red; mesoscutum blackish on front and side margins; apex reddish orange; scutellum reddish orange; gaster chestnut-brown; ♂, antenna and legs yellow, head and thorax black, scutellum and gaster chestnut-brown. Radial cell of forewing completely open at base and on wing margin, veins $Rs+M$ not indicated, Rs_2 weakly extended along margin of wing, R_2 not indicated, wing surface with long scattered cilia on apical third and scattered shorter cilia on remainder, wing margin with a distinct hair fringe apically.

MATERIAL EXAMINED

Holotype ♀, **Rwanda**: env. Astrida, 1954/1955 (*G. Foucart*) (MRAC, Tervuren).

Paratypes. **Rwanda**: 1 ♂, same data as holotype (badly damaged) (MRAC, Tervuren). **Uganda**: 1 ♀, Kampala, 24.x.1921 (*H. Hargreaves*) (BMNH).

REMARKS. This species is closely related to *striaticeps* but is distinguished by the long scattered pubescence on the mesoscutum.

Anacharoides astrida sp. n.

(Fig. 90)

DESCRIPTION. ♂. Antenna 14-segmented. Segment 3 of antenna as long as 3 plus 4, 3–8 each strongly swollen, remaining segments moniliform (Fig. 90). Head viewed frontally strongly reticulate and pubescent, eyes as far apart as the height of an eye, vertex arcuate, frontal carinae on inner orbits of eye crenulate, head viewed dorsally with frontal carinae extending from lateral ocellus, enclosing a finely reticulate area with transverse rugae, occiput strongly striated. Pronotal plate produced, pubescent either side with pronounced foveae medially; pronotum viewed dorsally angular, pubescent, mesoscutum finely reticulate with widely spaced irregular rugae striate on side margins, anterior parallel lines distinct in basal third, median scutal line complete, widened in apical quarter, notaulices complete, crenulate, obscured by the pubescence on the surface of mesoscutum; scutellum with apical depression almost quadrate, weakly arched on basal margin, scutellar foveae rounded basally, wider than apical half with fine reticulate area between apex and apical depression, apex of depression almost straight, sides of scutellum with large reticulate-rugose surface sculpture. Mesopleurae below mesopleural suture densely pubescent; carinae of propodeum almost parallel. Gaster with segment 1 smooth, petiolate, twice as long as broad, segment 2 liguliform, segment 3 viewed laterally the largest, densely punctate, remaining segments not visible. Hind tibia longitudinally ridged or furrowed with pronounced suberect spines on outer margin. Colour: antenna and legs orange-yellow, head and thorax black, gaster dark chestnut-brown. Forewing with short apical hair fringe, surface with widely scattered short pubescence, R_s of forewing weakly produced on wing margin, R_1 absent, i.e. radial cell completely open at base, $Sc+R$ not conspicuously angled at point where R_2 would normally emanate.

♀ not known.

MATERIAL EXAMINED

Holotype ♂, **Rwanda**: env. Astrida, 1954/1955 (*G. Foucart*) (MRAC, Tervuren).

Paratypes. **Tanzania**: 1 ♂, Ngorongoro, Pest Camp, 2400–2500 m, 6–19.vi.1957 (*P. Basilewsky & N. Leleup*) (MRAC, Tervuren). **Zaire**: 1 ♂, Kivu Sac (Lac Kivu), 1460 m, 19–22.ii.1934 (*G. F. de Witte*) (MRAC, Tervuren); 1 ♂ Secteur Tshiaberimu, Clieu-dit, 2450 m, 24.iii.1954 (*P. Vanschuytbroeck & H. Synave*) (MRAC, Tervuren); 1 ♂, P.N.A. Secteur Tshiaberimu, Riv. Kalvina, affl. dr. Talia N. 2720 m, 27.iii.1953 (*P. Vanschuytbroeck & V. Hendricx*); 1 ♂, Secteur Tshiaberimu, riv. Talia Nord, 2340 m, 28.iii.1954 (*P. Vanschuytbroeck & H. Synave*) (MRAC, Tervuren).

REMARKS. Distinguished from *eurytergis* Benoit by the seventh antennal segment being swollen apically.

Anacharoides decellus sp. n.

(Figs 76, 84, 85)

DESCRIPTION. ♀. Antenna 13-segmented, weakly subclavate, segment 3 longer than apical segment, shorter than 4 and 5. SN 1–13=AR 5:3:18:12:12:11:9:9:10:10:9:9:10. The apical segment darker than remainder. ♂ antenna 14-segmented, segment 3 expanded apically, 3 and 4 very weakly swollen medially on outer margin, remaining segments moniliform. Head viewed frontally with eyes as far apart as height of eye, vertex incised, frontal carina extending from outer margin of antenna to lateral ocellus, enclosing a reticulate area with weak transverse rugae, face below antenna with dense pubescence; occipital carinae pronounced, occiput strongly striate. Pronotum viewed dorsally, angular on side margins which are striated, with a small pronotal plate medially. Mesopleurae smooth and polished, mesosternum pubescent, mesonotum finely reticulate, notaulices distinct, not crenulate, median scutal line visible in apical quarter only as a triangular area, anterior parallel lines absent, surface of mesoscutum with fine scattered pubescence; scutellar foveae extending past middle of scutellum deep and polished, angular at apex, apical depression of scutellum rounded on basal margin, scutellum with

triangular area medially between foveae and apical depression, sides of scutellum strongly rugose, propodeum smooth and polished, carinae almost parallel, bowed at either end. Gaster with segment 1 smooth and polished, twice as long as wide, segment 2 liguliform, segment 3 the largest, closely punctate on lateral and dorsal margins, sides of propodeum and coxae pubescent, hind tibia with longitudinal furrow and suberect spines on outer margin viewed dorsally. Colour: ♀ antenna orange-yellow except apical segment dark brownish, legs brownish with yellowish tarsal segments, head reddish yellow, pronotum reddish dorsally, brownish laterally, mesoscutum black dorsally, scutellum reddish yellow, gaster chestnut-brown; ♂ head and thorax black. Radial cell of forewing completely open at base and on wing margin, veins $Rs+M$ not indicated, Rs_2 weakly extended along margin of wing. Wing surface ciliate, apical margin of wing with hair fringe, surface of wing with short scattered hairs apically.

MATERIAL EXAMINED

Holotype ♀, **South Africa**: Natal, Kloof, 1500 ft [450 m], August (R. E. Turner) (BMNH).

Paratypes. **Ethiopia**: 8 ♀, Mt Chillala Forest, circa 9000 ft [2700 m], 12.xi.1926 (H. Scott); 1 ♂, same data except 27.xi.1926 (BMNH); 1 ♂, Harrar, iii.1939 (H. C. Taylor) (BMNH). **Kenya**: 1 ♀, Chiromo, 7.viii.69, ex *Allograph calopus* (BMNH). **Nigeria**: 1 ♀ Njawai, NE. State, 24.viii.1973 (J. T. Medler) (BMNH). **Rhodesia**: 1 ♀, Chishawasha, nr Salisbury, ii.1978 (A. Watsham) (BMNH). **South Africa**: 6 ♀, Port St Johns, Pondoland, 1–14.v.1923 (R. E. Turner) (BMNH); 2 ♀, same data except 15–31.v.1923 (BMNH); 1 ♀, same data except 5–30.iv.1923 (BMNH); 2 ♀, same data except 12–30.vi.1923 (BMNH); 1 ♀, same data except 10–31.vii.1923 (BMNH); 4 ♂, same data except 12–30.vi. (R. E. Turner) (BMNH); 1 ♂, same data except 1–11.vi.1923 (BMNH); 1 ♀, Natal Kloof, 1500 ft [450 m], viii.1926 (R. E. Turner); 1 ♂, Natal, Weenen, vi.1925 (H. P. Thomasset) (BMNH); 1 ♀, Cape Province, Mossel Bay, v.1930 (R. E. Turner) (BMNH); 1 ♀, same data except x.1931 (BMNH) 1 ♂, same data except v.1930 (R. E. Turner) (BMNH); 1 ♀, Assegaaibosch, E. Stellenbosch, 4–5.i.1972 (BMNH). **Uganda**: 1 ♂, Kazhara, iii.1939 (H. C. Taylor) (BMNH). **Zaire**: 2 ♀, Secteur Nord, riv. Butahu, affl. Semliki, 1420 m, 26.vi.1957 (P. Vanschuytbroeck) (MRAC, Tervuren); 1 ♀ Mont Hoyo, 1250 m, 'sur plantes bases', 1–15.vii.1955 (P. Vanschuytbroeck) (MRAC, Tervuren); 1 ♀, Secteur Tshiaberimu, Mon. Kitwa, 2840 m, 29.viii.–7.ix.1953 (P. Vanschuytbroeck & V. Hendricx) (MRAC, Tervuren); 1 ♀, Massif Ruwenzori, ri. Kaklari, affl. Bombi (P. Vanschuytbroeck & H. Synave) (MRAC, Tervuren).

REMARKS. This species has close affinities with *nigra* but lacks the complete median scutal line and bright yellow gaster. The male resembles *suspensus* but is distinguished by the absence of transverse rugae on the mesoscutum.

Anacharoides elongaticornis Benoit

(Figs 45, 59, 60)

Anacharoides elongaticornis Benoit, 1956 : 201. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antenna 13-segmented, moniliform, 3 shorter than 4 plus 5, 4 and 5 equal, 6–12 subequal in length, 13 twice length of 12 (Fig. 59), 5–13 with rhinaria indicated. SN 1–13=AR 4 : 2 : 8 : 5 : 5 : 5 : 5 : 5 : 4 : 5 : 4 : 5 : 4 : 4 : 9. Head viewed from the front with eyes as far apart as height of an eye, frontal carina extending from outer margin of antenna to lateral ocellus, enclosing a rugose area, vertex incised, occiput strongly striated with strong curved striae. Pronotum viewed dorsally strongly coriaceous, angled on margins, mesoscutum with strong coriaceous-reticulate surface, anterior parallel lines indicated, notaulices complete though obscured in sculpture and by pubescence, median scutal line weakly indicated posteriorly; scutellum viewed laterally with pointed apex, fine coriaceous, viewed dorsally with apical depression, scutellar foveae not extending past middle of scutellum, separated by a septum, the surface coriaceous, the apex of each fovea angled, with a small triangular depression in front of apical depression, lateral bars with fine coriaceous sculpture, apex of scutellum arched (Fig. 60), propodeum with bowed carinae, sides densely pubescent. Mesopleura smooth and polished, episternum with longitudinal striae. Segment 1 of gaster petiolate, twice as long as wide, segment 2 liguliform, segment 3 the largest, closely punctate on lateral and dorsal margins of the upper apical half. Hind tibia with longitudinal furrows and suberect spines on outer margins, basitarsi as long as remaining combined segments.

Colour: antenna yellowish, head dark blackish red, thorax black, gaster black, front and middle legs yellowish, hind legs blackish brown, tarsi yellow. Forewing surface with widely scattered short pubescence, apical hair fringe very short, radial open on front and basal margins, Rs_2 almost closing wing

margin (vein at juncture with wing margin barely pigmented) (Fig. 45), veins $Rs+M$ not indicated, M (cubitus) weakly indicated.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, **Zaire**: Uele Paulis, xii.1947 (*P. L. G. Benoit*) (MRAC, Tervuren).

Anacharoides eurytergis Benoit

(Figs 72, 73, 74, 91)

Anacharoides eurytergis Benoit, 1956: 195–196. Holotype ♀, **ZAIRE** (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antenna 13-segmented, moniliform, 3 shorter than 4 plus 5, 4 and 5 subequal, 5 and 6 subequal, 6 longer than 7, 7 and 8 subequal, 8 longer than 9, 9 shorter than 10, 10 equal to 7, 10 and 11 equal, 11 shorter than 12, 13 twice as long as 12. SN 1–13=AR 8:3:11:6:5:6:6:5:5:4:5:5:5:5:5:11, segments 6–13 of equal width, 1st segment the widest. ♂. Antenna 14-segmented, segment 3 the longest, strongly excavated on outer margin, 4–6 distinctly swollen. SN 1–14=AR 6:3:3:14:10:10:10:10:8:8:8:8:8:11:5. Head viewed frontally with eyes as far apart as the height of an eye, frontal carina extending from outer margin of antenna to lateral ocellus, enclosing a finely reticulate, coriaceous area with transverse rugae, lower face pubescent, vertex incised (Fig. 74), occiput strongly striate with a strong occipital carina. Thorax: pronotum viewed dorsally strongly sculptured, obliquely angled apically with a small plate produced forward on front margin, surface of mesoscutum reticulate-coriaceous, obscured by dense pubescence, notaulices with widely spaced crenulations, median scutal furrow obsolete basally, visible apically, anterior parallel lines indicated, scutellum viewed laterally with pointed apex, reticulate rugose, viewed dorsally with apical depression; scutellar fovea extending past middle of scutellum, foveae separated by a septum and highly polished on basal half, apical half of each fovea elongated and weakly strigose, posterior part margined and excavate, without median carina; propodeum with bowed carinae. Mesopleurae smooth and polished, episternum sculptured. Segment 1 of gaster petiolate, longer than broad, smooth segment 2 of gaster liguliform, segment 3 the largest, closely punctate in the lateral and dorsal areas of the upper apical half. Hind tibia with a longitudinal furrow and suberect spines on outer margins. Colour: ♀, head, apex of mesoscutum, thorax and mesopleurae red, gaster black, front and middle legs yellow to brown, hind legs brownish black; ♂, head, thorax and hind legs black, antenna reddish brown basally, black at apex, front and middle legs brownish yellow. Surface of forewings with widely scattered short pubescence, apical hair fringe short, radial cell completely open at base and on wing margin, R_1 not indicated, $Sc+R$ at point where R_1 would emanate, angled (Fig. 72), veins $Rs+M$ not indicated, Rs_2 not reaching margin of wing.

MATERIAL EXAMINED

Holotype ♀, **Zaire**: Kivu, Ibanda, 1952 (*M. Vandelannoite*) (MRAC, Tervuren).

Nigeria: 2 ♀, W. State, Owena, ii.1970 (*J. T. Medler*) (BMNH); 1 ♀, Umuahia, Crin, EC. State, 10.iv.1975 (*J. T. Medler*) (BMNH). **Rhodesia**: 3 ♂, Chishawasha, nr Salisbury, ii.1978 (*A. Watsham*) (BMNH.) **South Africa**: 1 ♀, 5 ♂ Grahamstown, Southwell Rd, em. xi.1975, ex pupa of *Ischiodon aegyptus* reared on *Aphis nerii* on *Gomphocarpus physocarpus* (*J.B.*) (BMNH); 4 ♀, Zululand, Eshowe, vii.1926 (*R. E. Turner*) (BMNH); 3 ♀, Port St. Johns, Pondoland, 1–14.v.1923 (*R. E. Turner*) (BMNH); 2 ♀, same data except date, 1–11.vi.1923; 1 ♀, same data except 5–30.iv.1923; 1 ♀, same data except 12–30.vi.1923; 1 ♂, same data except 15–31.v.1923 (*R. E. Turner*) (BMNH); 1 ♀, Asseganibosch, E. Stellenbosch, 4–5.i.1972 (BMNH); 2 ♀, Natal, Kloof, 1500 ft, 450 m, viii.1926 (*R. E. Turner*) (BMNH); 1 ♀, Cape Province, Somerset East, x.1930 (*R. E. Turner*) (BMNH). **Zaire**: 2 ♂, Secteur Tshiaberimu, riv. Talia, Nord, 2340 m, 28.iii.1954 (*P. Vanschuytbroeck & H. Synave*) (MRAC, Tervuren); 1 ♂, same data except 23.iii.1954 (MRAC, Tervuren); 1 ♂, Secteur Tshiaberimu Husiangwa aff. Musabaki, 19.iii.1954 (*P. Vanschuytbroeck & H. Synave*) (MRAC, Tervuren); 1 ♂ (allotype), same data as holotype; 1 ♂ (paratype), Rwanki, 15.ii.1952 (*J. Leroy*) (MRAC, Tervuren).

Anacharoides nigra sp. n.

(Figs 71, 75, 105)

DESCRIPTION. ♀. Antenna 13-segmented, subclavate, segment 3 subequal to apical segment, shorter than 4+5, segment 3 weakly curved apically, 4–12 moniliform, each progressively shorter than the preceding

one, SN 3-13=AR 50:30:30:25:25:25:24:20:20:20:47. Head viewed frontally with eyes as far apart as height of an eye measured midway between the eyes, frontal carina pronounced, extending from outer margin of antenna to lateral ocellus, face coarsely reticulate rugose with fine pubescence, vertex incised, occiput strongly striated. Lateral margins of pronotum viewed dorsally angular. Mesoscutum dull, finely coriaceous, with very weak scattered transverse aberrant rugae and hairs, median scutal line visible in apical two-thirds, forming a long triangular impressed area, notaulices distinct, crenulate, wider at apex than at base, anterior parallel lines obsolete, lateral lines weakly indicated; scutellum viewed laterally with pointed apex dorsally with apical depression, strongly arched on basal margin. Scutellar foveae extending to middle of scutellum with apical area merging into a triangular shape in front of apical depression, sides of scutellum variably reticulate, carinae of propodeum parallel at midway point, converging at top; mesopleurae smooth and polished. Gaster with segment 1 petiolate, weakly furrowed, less than three times as long as broad, segment 2 liguliform, segment 3 the largest, closely punctate on apical two-thirds. Hind tibia longitudinally ridged or furrowed with suberect spines on the outer margins, hind coxae viewed dorsally longer than petiole, strongly swollen with long pubescence on outer margins, inner margins flattened. Colour: antenna, legs and gaster orange-yellow, head and thorax black. Forewings with apical hair fringe, surface with a few dotted hair bases at basal half, Rs_2 of forewing weakly produced, not reaching margin of wing, vein R_1 absent, i.e. radial cell open at base and on wing margin. $Sc+R$ angled at point where vein R_1 would normally be.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, **Uganda**: Kawanda, viii.1943 (*T. H. C. Taylor*) (BMNH).

Paratype. **Zaire**: 1 ♀, P. N. A. Secteur Tshiaberimu Riv. Mbulikere, affl. dr. Talia N. 2700 m, 26-28.viii.1953 (*P. Vanschuytbroeck & V. Hendricx*) (MRAC, Tervuren).

REMARKS. Closely related to *decellius* but distinguishable on characters given in the key.

Anacharoides pallida sp. n.

(Figs 77, 93)

DESCRIPTION. ♀. Antenna 13-segmented, weakly subclavate, segment 3 shorter than 4+5, 4 and 5 subequal, 6 and 7 subequal, 8 shorter than 7, 9-12 shorter than 8, subequal. SN 1-13=AR 12.5:4.5:22.5:12.5:12.5:11:11:10:7.5:7.5:7.5:7.5:15. Head viewed frontally with eyes as far apart as the height of an eye, frontal carinae crenulate, extending from outer margin of antenna to lateral ocellus, enclosing a fine rugose area with strong transverse rugae in upper area, vertex incised, subantennal sutures pronounced, face pubescent, occiput strongly striated. Pronotum viewed dorsally obliquely angled with a small protrusion medially; surface of mesoscutum finely reticulate-coriaceous with traces of weak transverse rugae on inner margins basally, anterior and lateral lines obsolete, median scutal line very weakly present in basal half, diverging to form a small obscure triangular area at apex, weakly strigose; notaulices complete and distinct with weak shallow crenulations. Scutellum viewed laterally, pointed, dorsally with apical depression straight on apical margin, base of depression arched, scutellar fovea elongate, polished, not extending past middle of scutellum, scutellar foveae separated by a broad septum, lateral bars broad, not sculptured, apical depression with a triangular area between its base and apex of scutellar foveae, scutellar disc with strong reticulate sculpture, mesopleurae polished with light pubescence below the mesopleural suture, carinae of propodeum weakly bowed. Segment 1 of gaster slightly longer than broad, petiolate, smooth and polished, segment 2 liguliform, segment 3 the largest, strongly punctate, remaining segments enclosed by the third. Hind coxae swollen, weakly pubescent, hind tibiae longitudinally ridged or furrowed with suberect spines on the outer margins. Colour: antenna orange-yellow, head, thorax and legs reddish orange, gaster reddish orange dorsally, yellow basally. Forewings with apical hair fringe, apical surface with scattered hairs, remainder dotted with hair bases, Rs_2 of forewing extending to margin of wing, not extended along margin, radial cell completely open at base, $Sc+R$ angled at point where vein R_1 would normally be.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, **South Africa**: E. Cape Province, Kathberg, 11-18.ii.1938 (*R. E. Turner*) (BMNH).

REMARKS. This species has close affinities with *eurytergis* but lacks the dense pubescence.

Anacharoides paragi Benoit

(Fig. 67)

Anacharoides paragi Benoit, 1956 : 200. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antenna 13-segmented, moniliform, weakly clavate, rhinaria present on segments 3–13, 3 shorter than 4+5, segments 6–12 gradually decreasing in length, segment 3 twice the length of 8, 9, 10, 11 or 12, 13 equal in length to segment 3, as long as 11+12. SN 1–13=AR 6:2:8:7:5:5:5:4:4:4:4:4:8. Head viewed from front with eyes as far apart as height of an eye, frontal carina extending from outer margin of antenna to lateral ocellus and enclosing a reticulate area, vertex incised, occiput strongly striate with strong occipital carinae. Pronotum viewed dorsally obliquely angled apically, mesoscutum reticulate rugose; notaulices complete and distinct with crenulations on apical section, the side margins of mesoscutum with short pubescence, median scutal furrow indicated posteriorly, anterior margins of mesoscutum with strigose sculpture; scutellum viewed laterally with pointed apex, reticulate rugose, viewed dorsally with apical depression, scutellar foveae round, extending past middle of scutellum, separated by a septum, apex of scutellum with large depression, straight on apical margin, sides of scutellum strongly reticulate rugose; carinae of propodeum weakly bowed at anterior. Mesopleura smooth and polished, suture distinct. Segment 1 of gaster petiolate, longer than broad, smooth, segment 2 of gaster liguliform, segment 3 the largest, closely punctate dorsally and laterally. Hind tibia with longitudinal furrows with dense comb of hairs on inner margin and a row of widely spaced spines on outer margin. Colour: antenna, head and thorax reddish brown, legs yellow to reddish brown, gaster chestnut-red-black. Surface of forewing with widely scattered hair bases and a few short hairs near apex, hair fringe on wing margin very short, vein Rs_2 thin, not reaching margin, R_1 absent, $Rs+M$ and M not indicated (Fig. 67), $Sc+R$ angled at point where R_1 would emanate.

♂ unknown.

MATERIAL EXAMINEDHolotype ♀, **Zaire:** Gandajika, 22.iii.1947 (*P. Henrard*) (MRAC, Tervuren).

Ghana: 1 ♀, Kumasi, Kwadaso, 28.iii.1977 (*Scheibelreiter*) (BMNH). **Nigeria:** 1 ♀, Umuahia Crinec State, 10.iv.1975 (*J. T. Medler*); 1 ♀, Zungeru, xi.1910 (*J. W. Scott-Macfie*) (BMNH); 4 ♀, Ile-Ife, W. State, v.1973 (*J. T. Medler*) (BMNH). **Rhodesia:** Chishawasha, nr Salisbury, ii.1978 (*A. Watsham*) (BMNH). **Sierre Leone:** 2 ♀, Njala, 2–15.i.1932 and 1931, ex syrphid puparium (*E. Hargreaves*) (BMNH). **Uganda:** 2 ♀, Kampala, 6.x.1928 and 8.x.1928, ex *Paragus burbonicus* (*G. L. R. Hancock*) (BMNH); 1 ♀, Kawanda, vi.1941 (*T. H. C. Taylor*). **Zaire:** 1 ♀ (paratype), same data as holotype except 5.iii.1948 (MRAC, Tervuren); 1 ♀, Haut-Uele, Moto, iv–v.1923 (*L. Burgeon*) (MRAC, Tervuren); 1 ♀, Leverille, ix.1920 (*P. Vanderjst*) (MRAC, Tervuren).

Anacharoides quadrus sp. n.

(Figs 78, 89)

DESCRIPTION. ♀. Antenna 13-segmented, very weakly subclavate, segment 3 longer than 4, shorter than 4+5, 4–6 subequal in length, 6–12 gradually decreasing in length, 13 as long as 3. SN 1–13=AR 10:3:15:9:9:9:9:7:7:7:7:6:15; apical segment darker than remainder. ♂ antenna moniliform, 14-segmented, segment 3 weakly expanded apically (Fig. 78), SN 1–5=AR 15:8:45:30:30. Head viewed frontally with eyes as far apart as height of eye, vertex incised, frontal carinae extending from outer margin of antennae to lateral ocellus, enclosing a reticulate area covered with scattered long hairs, occipital carina pronounced, occiput strongly striate. Lateral margins of pronotum with striations, pronotum viewed dorsally, angular, with a small pronotal plate on the front margin, no tooth present. Mesoscutum finely reticulate, covered with long white widely spaced hairs, median scutal line obscured by pubescence, notaulices complete with wide-spaced crenulations, obscured by long hairs, anterior parallel lines obsolete. Scutellum viewed laterally with pointed apex, dorsally with apical depression, not strongly arched on basal margin (almost straight), scutellar foveae elongate, extending past the middle of scutellum, basal half of foveae with triangular carinae (Fig. 89); sides of scutellum strongly rugose, carinae of propodeum almost parallel. Mesopleurae smooth and polished above the suture, densely pubescent below. Gaster with segment 1 petiolate, smooth, segment 2 liguliform, segment 3 viewed laterally the largest, closely punctate in dorsal and lateral margins, remaining visible segments punctate. Hind tibia longitudinally ridged or furrowed with pronounced suberect spines on outer margins. Colour: ♀ antenna, head, thorax and legs orange-red, gaster chestnut-brown, ♂ antenna, fore and mid legs yellowish,

head, mesonotum predominantly black, scutellar foveae reddish, hind legs brownish, gaster chestnut-brown. Forewings with apical hair fringe, surface with scattered hairs, Rs_2 of forewing produced along wing margin, vein R_1 absent i.e. radial cell completely open at base, $Sc+R$ angled at point where vein R_1 would normally be.

MATERIAL EXAMINED

Holotype ♀, **Rhodesia**: Salisbury, iv.1974 (*A. Watsham*) (BMNH).

Paratypes. **Rhodesia**: 2 ♂, Salisbury, same data as holotype (BMNH). **Uganda**: 1 ♂, 2 ♀, Kawanda, vii–viii.1943, ♂, viii.1942 (*T. H. C. Taylor*) (BMNH); 1 ♀, Bushenyi, iii.1939 (*T. H. C. Taylor*) (BMNH).

REMARKS. Related to the group of species with the apical depression of the scutellum appearing almost quadrate. The male is distinguished from all others by the shape of the antennal segments.

Anacharoides rufa (Kieffer)

Coelonychia rufa Kieffer, 1912: 451. Holotype, sex unknown, SOUTH AFRICA: Port Elizabeth (*Brauns*) (originally in MNHU, Berlin, now lost).

The holotype of this species cannot be traced. According to information received from Dr Königsmann in 1976 it could be in a collection on loan of which records have been lost.

Anacharoides sanitas sp. n.

(Figs 46, 62, 69, 88, 92)

DESCRIPTION. ♀. Antenna 13-segmented, filiform, 3 shorter than 4+5, SN 3–13=AR 12:7:7:7:7:7:6:6:6:6:12, 4–8 equal in length, 9–10 equal, 11–12 equal, 13 twice length of 12. ♂. Antenna with segment 3 swollen on apical half, longer than segment 4, less than 4+5 (Fig. 88), 4 and 5 swollen apically, remaining segments moniliform, subequal in length. Head viewed frontally with eyes as far apart as the height of an eye, frontal carina extending from outer margin of antenna to lateral ocellus, enclosing a rugose area (pentagonal area), vertex incised, occiput striated, striae curved (Fig. 92). Pronotum viewed dorsally angled on side front margins, mesoscutum with reticulate-rugose sculpture, anterior parallel lines indicated, notaulices complete with weak crenulate appearance, median scutal line complete, apical triangular area extending to middle of mesoscutum, lateral lines indicated. Scutellum viewed laterally with pointed apex, reticulate-rugose, viewed dorsally with apical depression, scutellar foveae extending past middle of scutellum, separated by a septum, the apex of each fovea triangular, enclosing between them a triangular area, apex of scutellum not arched, with a semicircular depression, lateral bars of scutellum striate (Fig. 62). Mesopleurae smooth and polished, episternum with longitudinal striae, propodeum with weakly bowed carinae, weakly pubescent either side of carinae. Segment 1 of gaster petiolate, longer than broad, smooth, segment 2 of gaster liguliform, segment 3 the largest, closely punctate on apical half dorsally and laterally. Hind tibia with longitudinal furrows and suberect spines on outer margins, with a dense pubescent comb of hairs on inner margin and a row of widely placed spines on outer margin. Colour: head red, pronotum red, mesoscutum reddish brown, gaster reddish on lateral margins, reddish brown at apex, antennae and legs reddish. Forewings with short apical hair fringe, surface with dotted hair bases, radial cell of forewing open on the margin and at base, Rs_2 not reaching margin of wing, cubitus (*M*) not indicated.

MATERIAL EXAMINED

Holotype ♀, **South Africa**: Cape Province, Mossel Bay, x.1921 (*R. E. Turner*) (BMNH).

Paratypes. **Ethiopia**: 1 ♀, Mt Zuguala, c. 9000 ft [2700 m], 22.x.1926 (*H. Scott*) (BMNH). **Kenya**: 1 ♀, Kiambu, 12.viii.1929 ex syrphid pupa (*R. H. Le Pelley*); 1 ♀, Mt Kenya, Kathita river, 9000 ft [2700 m], 9.viii.1949 (*J. A. Riley*) (BMNH). **Nigeria**: 1 ♀, Zaria, Samaru, 22.ii.1974 (*J. L. Musa*) (BMNH). **South Africa**: 1 ♀, Cape Province, Somerset East, 10–22.xii.1930 (*R. E. Turner*) (BMNH); 9 ♂, same data as holotype, varying dates (BMNH); 1 ♂, Cape Province, Mossel Bay, 28.vi.1938 (*R. E. Turner*) (BMNH); 1 ♂, Capetown, x.1937 (*R. E. Turner*) (BMNH); 1 ♀, Port St. Johns, Pondoland, 10–31.vii.1923 (*R. E. Turner*) (BMNH). **Uganda**: 1 ♀, Mt Elgon, 6.viii.1934 (*J. Ford*) (BMNH). **Yemen**: 2 ♀, Usaifira, 1 mile N. of Ta'izz, c. 4500 ft [1350 m], 12.xii.1937 (*H. Scott & E. B. Britton*) (BMNH); 1 ♂, Sanā, c. 7900 ft [2370 m], 19.i.1938 (*H. Scott & E. B. Britton*) (BMNH). **Zaire**: 1 ♀ Katanga, Dilolo, 24–27.vii.1931 (*J. Ogilvie*) (BMNH).

REMARKS. Resembles *quadrus* but is clearly separated from it on a number of characters as indicated in the key.

Anacharoides striaticeps Cameron

(Figs 63, 81, 86, 87)

Anacharoides striaticeps Cameron, 1904a : 160. Holotype ♀, SOUTH AFRICA (BMNH) [examined].*Coelonychia spinosipes* Kieffer, 1910c : 19–20. Holotype ♀, MALAWI: Nord-Nyassa, Langenburg (*Fulleborn*) (originally in MNHU, Berlin, now lost?). (Synonymy by Weld, 1930 : 139.)*Anacharoides gibbosus* Benoit, 1956 : 198. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined]. **Syn. n.**

DESCRIPTION. ♀. Antenna 13-segmented, weakly clavate, 3 longer than 4, shorter than 4+5, 4 and 5 subequal, 7–12 decreasing gradually in length (Fig. 87). SN 1–13=AR 8 : 3 : 9 : 5 : 5 : 5 : 4 : 5 : 4 : 5 : 4 : 4 : 4 : 4 : 7, the apical two segments darker than remainder, segments 4–13 with rhinaria, 13 as long as 11+12. ♂. Antenna 14-segmented, segment 3 the longest, strongly excavated on outer margin, 4 strongly swollen, narrow at base, 5–13 not swollen, SN 1–5=AR 5 : 3 : 9 : 5 : 5 : 5 : 5 : 5. Head viewed frontally with eyes as far apart as the height of an eye, frontal carina extending from outer margin of antenna to lateral ocellus, enclosing a strongly reticulated area between median ocellus and antennal sockets. Occiput strongly striate with a strong occipital carina. Pronotum with weak strigose sculpture, pubescent on sides, angled apically with a small indistinct plate on front margin; no tooth medially. Mesoscutum reticulate-coriaceous with fine evenly spaced white pubescence and transverse rugae, notaulices complete, but broken by crenulations, anterior parallel lines indicated, median scutal furrow obsolete. Scutellum viewed laterally with pointed apex, viewed dorsally with apical depression, scutellar fovea elongate, shallow, extending past middle of scutellum, foveae separated by a septum, each fovea polished, carinae of propodeum almost parallel; mesopleurae smooth and polished, suture indicated. Segment 1 of gaster petiolate, three times as long as wide, smooth; segment 2 of gaster liguliform, segment 3 the largest viewed laterally, closely punctate in lateral and dorsal views. Hind tibia with longitudinal furrows and distinctive suberect spines on outer margins. Colour: ♀, head, pronotum, scutellum, antenna and legs reddish, mesoscutum blackish brown, gaster chestnut-brown-red; ♂, antenna, legs orange-yellow, head and thorax black, gaster chestnut-brown-red. Forewings with only sparse hair fringe on lower apical margin, surface of wing with scattered pubescence on apical half, middle with dotted hair bases, *Rs*₂ extends along margin of wing for a short way without touching margin, vein *R*₁ not present, *Sc*+*R* not distinctly angled at the point where *R*₁ would normally emanate (Fig. 86).

MATERIAL EXAMINED*Anacharoides striaticeps* Cameron, holotype ♀, **South Africa**: Pearston (*Robert Brown*) (BMNH) [right antenna, left midleg, one fore and hind leg on right side, wings on left side missing]. *Anacharoides gibbosus* Benoit, holotype ♀, **Zaire**: Rutshuruji, i.1937 (*J. Ghesquiere*) (MRAC, Tervuren).

Angola: 1 ♀, 7 miles [11 km] W. Gabela, 16–18.iii.1972 (BMNH). **Nigeria**: 1 ♀, Ile-Ife, W. State, x.1973 (*J. T. Medler*). **South Africa**: 1 ♀, Cape Province, Somerset East, x.1930 (*R. E. Turner*) (BMNH); 2 ♀, Port St Johns, Pondoland, 1–4.v.1923 (*R. E. Turner*) (BMNH). **Uganda**: 1 ♀, Budongo Forest, 7.ii.1935 (*F. W. Edwards*) (BMNH); 3 ♀, Kazhara, iii.1939 (*T. H. Taylor*) (BMNH); 1 ♀, ? Ruzumbira, c. 1939 (*R. E. Turner*) (BMNH). **Zaire**: 1 ♂ (allotype of *gibbosus*), same data as holotype except 15.vi.1937 (MRAC, Tervuren); 1 ♀ (paratype of *gibbosus*), same data as holotype (MRAC, Tervuren); 1 ♀, Massif Ruwenzori, Kiurama, 2100 m, 26.x.1953 (*P. Vanschuytbroeck & V. Hendricx*) (MRAC, Tervuren); 1 ♀, Secteur Nord, Mulingo, 1300 m, Secteur Kikura, 9.vii.1954 (*P. Vanschuytbroeck & H. Synave*) (MRAC Tervuren).

Anacharoides stygius Benoit

(Figs 64, 65, 66)

Anacharoides stygius Benoit, 1956 : 197–198. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antenna 13-segmented, moniliform, weakly clavate, segment 3 1.5 times length of 4, 4 and 5 equal, 13 larger than 11+12. SN 1–13=AR 5 : 3 : 11 : 5 : 6 : 5 : 6 : 6 : 5 : 5 : 4 : 4 : 4 : 4 : 9. Head viewed frontally with eyes slightly further apart than height of an eye, frontal carina extending from outer margin of antenna to lateral ocellus, enclosing a strongly reticulated area between median ocelli and antennal sockets; occiput strongly striate with pronounced genal carinae. Pronotum with strong striate strigose sculpture, angled apically with a small indistinct plate on front margin; mesoscutum with fine reticulate sculpture and widely spaced transverse rugose sculpture, notaulices complete, distinct anterior parallel lines indicated, median scutal furrow extending to middle of mesoscutum. Scutellum in lateral view pointed at apex, viewed dorsally with apical depression, scutellar fovea extending past middle of

scutellum, separated by a narrow septum with small margined triangular area in front of apical depression (Fig. 64), sides of scutellum strongly reticulate. Mesopleurae smooth and polished, propodeum with parallel carinae converging and joining at either end. Segment 1 of gaster petiolate, longer than wide, smooth, segment 2 of gaster liguliform, segment 3 the largest, apical two-thirds dorsally and laterally closely and finely punctate, punctures extending to remaining visible tergites. Hind tibia with longitudinal furrows and widely spaced spines on outer margins (cf. Fig. 46). Colour: antenna, head and mesopleurae reddish yellow, thorax blackish, gaster and legs chestnut-red-brown, hind coxa swollen, strongly coriaceous with a polished shiny area on inner margins. Forewing with ciliate surface on apical half and scattered hair bases; hair fringe on apical margin short, vein Rs_2 thick, reaching wing margin, R_1 absent $Rs+M$ and M not indicated (Fig. 65), $Sc+R$ angled at point where R_1 would emanate.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, **Zaire**: Kiniata-Zobe, end xii.1915 (*R. Mayne*) (MRAC, Tervuren).

Madagascar: 1 ♀, Bekily, iv.1942 (*A. Seyrig*) (MRAC, Tervuren); 1 ♀, Bekily, vii.1940 (*A. Seyrig*) (MNHN, Paris). **Nigeria**: 2 ♀, Ile-Ife, W. State, v. and x.1973 (*J. T. Medler*) (BMNH). **Tanzania**: 2 ♀, Kilimanjaro Marangu, 13–20.vii.1957 (*P. Basilewsky & N. Leleup*) (MRAC, Tervuren). **Zaire**: P. N. A. Secteur Tshiaberimu, Kirungu (lieu-dit) 2720 m, 28.iii.1954 (*P. Vanschuytbroeck & H. Synave*) (MRAC, Tervuren).

Anacharoides suspensus sp. n.

(Figs 61, 68, 79, 82, 83)

DESCRIPTION. ♀. Antenna 13-segmented, elongate moniliform, segment 3 longer than 4, shorter than $4+5$, 4–12 gradually decreasing in length, apical segment equal in length to 3. SN $3-13=AR$ $12:9:8:8:7:7:6:6:6:6:12$. Head viewed frontally with frontal carina extending from outer margin of antenna to lateral margin of eye, face densely pubescent, obscuring the sculptured surface, mandibles with three teeth; vertex incised with frontal carina continued between lateral ocelli, eyes as far apart as height of an eye. Pronotum with a small median dorsal tooth obliquely angled on side margins with a small pronotal-type plate centrally. Mesoscutum with close transverse rugae and scattered pubescence, notaulices complete and crenulate, median scutal line distinct from posterior to middle, obscured anteriorly, triangular at posterior (Fig. 61), anterior parallel lines obsolete. Scutellum viewed laterally with apex pointed, viewed dorsally with apical depression, the basal margin straight, scutellar foveae not extending past middle of scutellum, angled at apex to form a triangular area, lateral bars with fine broken striate sculpture, apex of apical depression viewed dorsally, straight, posteriorly excavate. Mesopleura smooth and polished, episternum pubescent, carinae of propodeum weakly bowed on inner margins. Segment 1 of gaster petiolate, smooth dorsally, weakly furrowed laterally, segment 2 liguliform, segment 3 the largest, closely punctate on lateral and dorsal surfaces, the visible part of segment 4 punctate. Hind tibia with longitudinal furrows, closely pubescent on inner margin with long scattered spines on outer margin, basitarsi as long as remaining tarsal segments. Hind coxae strongly swollen viewed laterally, with polished excavation on inner margins, remainder of surface densely pubescent, inner margins with comb-like hair fringe (Fig. 83). Colour: ♀, antenna entirely orange-yellow, head orange-yellow, pronotum reddish orange, mesonotum reddish suffused with black on outer margins, gaster chestnut-red, legs reddish orange; ♂, same colour as ♀, antenna 14-segmented, segment 3 distally expanded (Fig. 79), 4–14 moniliform. Forewings dotted with short hair bases, apical hair fringe short, radial cell open on front and basally, vein Rs not reaching margin, not extending along wing margin, veins $Rs+M$ not indicated, vein R_1 absent, $2rm$ distinct.

MATERIAL EXAMINED

Holotype ♀, **Senegal**: Bambey, ex *Ischiodon aegypticum* (*J. Risbec*) (BMNH).

Paratypes. **Nigeria**: 1 ♀, Zaria, Samaru, 19.ix.1973 (*B. Yashim*) (BMNH). **Senegal**: 1 ♂, same data as holotype (BMNH).

REMARKS. The male has similar antenna to the female of *decellius* but differs by the sculpture of the mesoscutum. The female has affinities with those species bearing a quadrate scutellar depression.

PROSASPICERA Kieffer

Prosaspicera Kieffer, 1907: 157. Type-species: *Prosaspicera ensifera* Kieffer, by subsequent designation (Rohwer & Fagan, 1907).

DIAGNOSIS. ♀ antenna 13-segmented, filiform, ♂ 14-segmented with a modified segment 3. Head viewed frontally, coriaceous, inner margins of eye with a carina extending from lateral ocellus to the occiput, vertex incised. Pronotum viewed dorsally raised in the form of a lip, mesoscutum reticulate to coriaceous, median scutal line, anterior parallel lines and notaulices present; scutellar foveae distinct, apical spine of scutellum long and sharply pointed at apex, in dorsal view extending back to base of radial cell. Segment 1 of gaster short, wider than long, weakly furrowed, segment 2 of gaster liguliform, spherical viewed laterally, segment 3 the largest, punctate, almost reaching apex of gaster. Hind tibia longitudinally furrowed on inner margins. Forewings hyaline, usually bare, sometimes with apical hair fringe, radial cell open on front margin, generally open at base.

DISTRIBUTION. Belize; Brazil; Chile; Formosa; Malawi; U.S.A.

DISCUSSION. The type-species of this genus is extra-limital and the generic description is based on the original description by Kieffer, examination of a syntype (labelled paratype), a ♀ No. 26017 in the United States National Museum, Washington, and on the Ethiopian species of *Prosaspicera* discussed in this paper. I have been unable to see the syntypes housed at Pomona referred to by Weld (1952). One other specimen labelled '*Prosaspicera ensifera* K. det. Weld 1934' with the locality 'Mex 215H collection C. F. Baker' has been examined.

Key to Ethiopian species of *Prosaspicera* Kieffer

Females (unknown in *tropica*)

- 1 Antenna weakly subclavate, segment 3 longer than 4 (Figs 49, 100). Wing margin with complete hair fringe 2
- Antenna filiform (Figs 50, 94, 99), segment 3 at most as long as 4. Wing margin with hair fringe either present or absent 3
- 2 Notaulices very wide at apex with wide-spaced transverse carina on a reticulate base, median scutal line forked near apex to form a polished horseshoe-shaped area, lateral bars of scutellum reticulate, merging into lateral lines of scutellum. Scutellar foveae deep, very finely reticulate, separated by a shallow septum. Base of scutellar spine with three carinae merging into a striate medial area (Fig. 51). Radial cell of forewing with R_1 distinctly longer than wide, R_2 curved, extended along wing margin (Fig. 41). Mesopleurae polished on upper half, mesopleural suture obscured by strigose sculpture on lower half (Fig. 52).
Apical segment of antenna longer than segment 11 + 12 *antennata* (Benoit) (p. 107)
- Notaulices wide with closely spaced transverse carina, median scutal line forked near apex to form a polished triangular area, lateral bars of scutellum reticulate at base, merging into lateral margins of scutellum, scutellar foveae deep, reticulate-coriaceous, separated by a broad septum. Base of scutellar spine broad with longitudinal carinae extending two-thirds of its total length. Radial cell of forewing with R_1 short, not longer than wide, R_2 straight, not projecting along wide margin (Fig. 53). Mesopleurae sculptured on the lower half, coriaceous on upper half *paragigida* (Benoit) (p. 108)
- 3 Gena viewed laterally reticulate-coriaceous, expanded (Fig. 54); upper facial area between the frontal carinae reticulate-coriaceous (Fig. 54). Median scutal line dividing medially to form a horseshoe-shaped area apically, notaulices not crenulate (Fig. 55). Scutellar foveae polished, scutellar spine narrow basally (Fig. 55).
Forewing without apical hair fringe. Apical segment of antenna as long as segment 11 + 12 *optimus* sp. n. (p. 108)
- Gena viewed laterally not expanded. Median scutal line dividing medially to form an angular shaped area apically (Fig. 47); notaulices complete, crenulate, foveae sculptured 4
- 4 Frontal area between median ocellus and antennal sockets weakly strigose, becoming finely reticulate-rugose, eyes viewed frontally strongly swollen closer together than height of an eye measured at the median (Fig. 57), face with strong triangular depression covered in dense white pubescence extending up between antennal sockets, vertex sharply incised
kisantua (Benoit) (p. 107)
- Frontal area between median ocellus and antennal sockets strongly strigose, eyes viewed frontally not strongly swollen, as far apart as height of an eye (Fig. 56), face with weak depression below median ocellus, weakly pubescent, vertex not sharply incised
africana Kinsey (p. 106)

Males (unknown in *antennata* and *optivus*)

This key should be treated with caution as only a single male is known of each species.

- 1 Median scutal line with triangular depression at apex dull and coriaceous. Scutellar foveae each with a central longitudinal carina continued together with median carinae separating the foveae down the scutellar spine. Upper face with strong radiating striae extending to antennal scrobes (Fig. 58) *tropica* (Kieffer) (p. 109)
- Median scutal line with depression at apex either polished and triangular or arcuate basally and coriaceous. Scutellar foveae smooth and polished or coriaceous-reticulate, with a central carina in each, not continued along scutellar spine. Upper face coriaceous, rugose or at most with broken striae not extending to antennal scrobes 2
- 2 Apical depression of median scutal line polished with aberrant sculpture. Outer orbits of face with radiating striae, median area reticulate 3
- Apical depression of median scutal line dull with fine sculpture. Outer orbits of face with faint broken striae merging into coriaceous sculpture.
Scutellar foveae deep, surface reticulate-coriaceous, scutellar spine with three distinct carinae extending two-thirds of way along the spine from apex of scutellar foveae. Spine completely black *paragicida* (Benoit) (p. 108)
- 3 Upper face strongly rugose. Median scutal line with apical depression arcuate basally, weakly coriaceous on a shiny surface (Fig. 47). Scutellar foveae weakly striated on a polished reticulate surface. Notaulices weakly crenulate. Scutellar spine completely black *africana* (Kinsey) (p. 106)
- Upper face with broken striae. Median scutal line with apical depression triangular, basally deep and shiny, notaulices with strong crenulations. Scutellar spine chestnut-brown *kisantua* (Benoit) (p. 107)

Prosaspicera africana (Kinsey) **comb. n.**

(Figs 47, 56, 94, 95, 101)

Aspicera africana Kinsey, 1919 : 162–163. LECTOTYPE ♀, SOUTH AFRICA (KSM, Kansas), here designated [examined].

DESCRIPTION. ♀. Antenna filiform, segments 3–6 subequal in length, 7–12 gradually decreasing in length, segment 13 longer than 12, rhinaria present on segments 3–13. SN 3–13=AR 32 : 32 : 31 : 31 : 25 : 25 : 25 : 25 : 25 : 25 : 52. ♂. Antenna 14-segmented, moniliform (9 segments only left on the paralectotype), segment 3 excavate at base (Fig. 101). Head with face viewed frontally, coriaceous, eyes as far apart as height of an eye, frons raised, inner margins of eye with a carina extending forward, head viewed dorsally with distinct carina extending from lateral ocellus to antenna and beyond, upper face irregularly rugose, pubescent, cheeks pubescent, mandibles dark orange-brown, occipital carina distinct, occiput striated; vertex with angular depression (Fig. 95). Sides of pronotum pubescent on a coriaceous surface, front of pronotum viewed dorsally raised in form of a lip, mesoscutum reticulate-coriaceous, median scutal line visible anteriorly in the form of an arcuate depression at posterior, anterior parallel lines raised, extending almost half way to scutellar foveae, notaulices complete, weakly crenulate, wide posteriorly, narrowing anteriorly. Lateral bars of scutellum reticulate-coriaceous, extending past the scutellar fovea, scutellar disc truncate either side of scutellar spine and with hair tufts. Viewed dorsally, scutellar foveae polished, deep with striations, foveae separated by a septum which continues along the scutellar spine, spine of scutellum wide-based with striated dorsal surface, narrowing to a sharp spine (Fig. 47). Mesopleurae polished with a suture and weak strigose sculpture, propodeum and metapleurae pubescent. Segment 1 of gaster short, wider than long viewed laterally, weakly furrowed, segment 2 of gaster liguliform, spherical viewed laterally, segment 3 the longest, almost reaching apex of gaster, punctate on apical two-thirds, remaining segments short, punctate. Hind tibia longitudinally furrowed. Colour: antenna, legs reddish brown, head, thorax and gaster brownish black. Forewing with short apical hair fringe in ♀, present on upper margin only in ♂, apex of wing with sparse scattered hairs, remainder with widely spaced spicules, radial cell distinctly open on front and apex (Rs_2 and R_1 not reaching wing margin), areolet absent.

MATERIAL EXAMINED

Lectotype ♀, **Rhodesia**: Salisbury, 5050 ft [1515 m], vi.1900 (*F. L. Snow*) (KSM, Kansas).

Rhodesia: 4 ♀, Chishawasha, nr Salisbury, ii.1978 (*A. Watsham*) (BMNH); 1 ♀, Salisbury, 1969 (*A. Watsham*) (BMNH); 1 ♂ (paralectotype), Salisbury, 5050 ft [1515 m], xii.1900 (*F. L. Snow*) (KSN, Kansas).

REMARKS. A second male paralectotype in the Kinsey collection (same data as lectotype except xii. 1900) was not examined.

***Prosaspicera antennata* (Benoit) comb. n.**

(Figs 41, 43, 49, 51, 52, 96)

Aspicera antennata Benoit, 1956 : 202. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antenna 13-segmented, subclavate, segment 3 longer than 4, 4 and 5 equal, 6 as long as 3, 7 as long as 4, 8 as long as 4, 9, 10, 11 and 12 shorter than 8, 13 longer than 11 + 12 (Fig. 49), SN 3–13 = AR 14 : 13 : 13 : 14 : 13 : 13 : 11 : 11 : 10 : 10 : 22, 3–13 with rhinaria. Head viewed dorsally with carina extending from outer margin of antenna to lateral ocellus enclosing a fine reticulate area, occipital carinae pronounced, vertex incised, back of head below ocelli with canaliculate sculpture (Fig. 96); mesoscutum with distinct notaulices, wider at apex and crenulate, anterior parallel lines indicated, median scutal line extending to middle of mesoscutum where it widens and joins the scutellum at the scutellar suture, surface finely reticulate. Scutellar spine viewed laterally in same plane as scutellar foveae, extending almost to basalis (Fig. 51). Mesopleura polished medially with lateral striations on lower half; lateral bars of scutellum reticulate at base, becoming striated on side margins, scutellar foveae very finely coriaceous, separated by a narrow septum, surface of disc finely reticulate, base of spine broad, gradually tapering towards apex (Fig. 51), base either side of spine with tufts of pubescence. Mesopleura polished on upper half, strongly strigose on lower half (Fig. 52). Segment 1 of gaster viewed laterally, wider than long, crenulate, segment 2 of gaster liguliform, segment 3 the largest, the apical half dorsally and laterally with dense punctures. Hind tibia with longitudinal furrows. Colour: ♀ antenna with segments 1 and 2 chestnut-brown (ferruginous), 3–13 orange-yellow, head and thorax black, gaster dorsally and upper lateral margins chestnut-brown, apical margins yellowish, legs orange-yellow. Forewings with a colourless apical fringe, surface of wing with spicules except for a few sparse hairs apically, radial cell open at base and apex (Rs_2 and R_1 not reaching wing margin) (Fig. 41), R_1 short, longer than wide, weakly projecting (Fig. 41), areolet absent, $2rm$ in form of a spur, cubitus (M) absent, hair fringe on apical margin short.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, Zaire: Basoko, xii. 1948 (*P. L. Benoit*) (MRAC, Tervuren).***Prosaspicera kisantua* (Benoit) comb. n.**

(Figs 42, 48, 57, 98, 99)

Aspicera kisantua Benoit, 1956 : 203–204. Holotype ♂, ZAIRE (MRAC Tervuren) [examined].

DESCRIPTION. ♂. Antenna 13-segmented, filiform, segments 3–6 equal in length, 7–9 equal in length, each shorter than 3, 10 and 11 each shorter than 9, 12 shorter than 11, 13 longer than 11 + 12. Sn 3–13 = AR 17 : 17 : 17 : 17 : 15 : 15 : 15 : 14 : 14 : 13 : 28, rhinaria present on segments 3–13. ♂ antenna 14-segmented, segment 3 expanded apically, 4–13 moniliform, subequal in length, apical segment longer than penultimate. Head viewed dorsally with distinct frontal carina extending from outer margin of lateral ocellus to antenna, enclosing a finely reticulate area, eyes further apart than height of an eye, occipital carinae distinct, vertex incised, back of head with wide longitudinal furrows (Fig. 98). Pronotum viewed dorsally densely pubescent, angled on side margins with a small protruding pronotal plate; surface of mesoscutum with reticulate-coriaceous sculpture, notaulices complete with strong crenulate sculpture, median scutal line extending from base, diverging at a point midway to enclose a polished area, anterior parallel lines not extending to halfway down mesonotum, lateral bars of scutellum reticulate at base, weakly striate apically. Scutellar foveae shallow with wide-spaced crenulations separated by a septum, scutellar disc with longitudinally strigose sculpture interspaced with reticulations at apex; scutellar spine wide at base, rugose, extending as far as apical margin of tergite two viewed dorsally. Mesopleura smooth and polished anteriorly, with weak striations and coriaceous sculpture basally; sides of propodeum densely pubescent. Segment 1 of gaster wider than long, obscured by tergite 2, tergite 2 liguliform, tergite 3 the largest, strongly punctate on lateral and dorsal surfaces of apical two-thirds. Hind tibia with longitudinal furrows. Colour: antenna and legs reddish yellow, head and thorax black, gaster black with dark chestnut tinge at base and on ventral margins. Forewings with hair fringe present on upper apical margin only, surface of wing dotted with widely spaced spicules, radial cell open on front margin (Rs_2 and R_1 not reaching wing margin), areolet absent, R_1 short and weakly projecting, $2rm$ in form of a spur, cubitus (M) absent (Fig. 42).

MATERIAL EXAMINED

Holotype ♀, **Zaire**: Bas-Congo, Kissantu, 1931 (*R. P. Vanderyst*) (MRAC, Tervuren).

Ghana: 1 ♀, ex syrphid on *Gusicidia* (BMNH). **Nigeria**: 1 ♀, Ile-Ife, 2.viii.1969 (*J. T. Medler*) (BMNH).

Sierra Leone: 1 ♂, 1 ♀, Njala, 1931 ex syrphid on groundnuts (*E. Hargreaves*) (BMNH).

Prosaspicera optivus sp. n.

(Figs 50, 54, 55, 97)

DESCRIPTION. ♀. Antenna 13-segmented, filiform, 3 shorter than 4, 4 and 5 subequal, 6–12 each decreasing very slightly in length, 13 longer than 12. SN 3–13 = AR 17 : 19 : 19 : 16 : 14 : 13.5 : 12.5 : 11 : 10 : 11 : 22, rhinaria present on segments 3–13. Head viewed dorsally with distinct frontal carina extending from outer margin of lateral ocellus to antenna, viewed laterally with reticulate-coriaceous sculpture between occipital carina and margin of eye, genal area wide (Fig. 97), vertex incised, occipital carinae viewed dorso-posteriorly, expanded, vertex with canaliculate sculpture (Fig. 97). Pronotum weakly pubescent on side margins with a small protruding pronotal plate. Surface of mesoscutum with reticulate sculpture, median scutal line dividing medially to form a horseshoe-shaped area, anterior parallel lines short, not extending to middle of mesoscutum, notaulices complete, smooth and polished, lateral bars of scutellum reticulate, merging into margin of the scutellar disc. Scutellar foveae smooth and shiny, with a septum continued along the dorsal surface of the acutely pointed spine, apex of disc truncate, spine at base arising from above the apex of scutellar disc (Fig. 55). Mesopleurae smooth and polished anteriorly, strigose in part basally; sides of propodeum pubescent. Segment 1 of gaster wider than long, obscured by tergite 2, tergite 2 liguliform, tergite 3 the largest viewed laterally, the apical third strongly punctate, remaining segments hardly visible. Hind tibia with longitudinal furrows on inner margins. Colour: antenna and legs reddish yellow, head, mesoscutum, scutellum and apical segments of gaster black, anterior half of mesopleurae and basal segments of gaster reddish. Forewings without apical hair fringe, surface of wing dotted with widely spaced spicules, radial cell open on front margin (R_2 reaching wing margin, R_1 not reaching wing margin), areolet absent, 2*rm* not in form of a spur.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, **Congo**: Cayo Dist., Central Farm, x.i.1975, on *Zea mays* L. (*R. Akers*) (BMNH).

REMARKS. This species is distinguished from others with a filiform antenna by the very distinctive expanded gena.

Prosaspicera paragicida (Benoit) comb. n.

(Figs 53, 100, 102)

Aspicera paragicida Benoit, 1956 : 202–203. Holotype ♀, **ZAIRE** (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antenna 13-segmented, weakly clavate, segment 3 longer than 4, 4 and 5 equal, SN 1–13 = AR 20 : 6 : 16 : 13 : 15 : 15 : 13 : 13 : 13 : 13 : 13 : 26, segments 9–12 almost as broad as long (Fig. 100), rhinaria present on 3–13. ♂. Antenna 14-segmented. SN 3–5 = AR 20 : 16 : 17. Segment 3 strongly expanded apically (Fig. 102), rhinaria on segments 3–14. Head viewed dorsally with frontal carina extending from outer margin of antenna to lateral ocellus, not distinct, enclosing a fine reticulate area with radiating sculpture in part, occipital carina distinct, occiput with widely spaced canaliculate sculpture (cf. Fig. 97). Pronotum viewed dorsally, angled on the margins. Mesoscutum with fine reticulate sculptured surface, notaulices distinct, complete, wide at apex and crenulate, lateral lines complete, anterior parallel lines not reaching halfway to apex, median scutal line reaching halfway to apex and branching to enclose a polished wide triangular area. Mesopleurae polished on upper half with fine striate sculpture and a carina (a mesopleural suture) in middle section. Scutellar spine viewed laterally in the same plane as scutellar foveae, strongly ridged; scutellum finely reticulate with longitudinal strigose sculpture continued along spine, scutellar fovea deep, surface reticulate-coriaceous, separated by a weak septum, the apex of scutellum either side of spine pubescent. Segment 1 of gaster viewed laterally wider than long, crenulate, segment 2 of gaster liguliform, segment 3 the largest, the apical two-thirds with dense punctures dorsally and laterally. Hind tibia with longitudinal furrows. Colour: antenna, legs reddish yellow, head, thorax and gaster black, apex of gaster with dark chestnut-brown tinge. Forewing with radial cell open at base and apex (R_2 and R_1 not reaching margin of wing), R_1 short, conical, as wide as long measured at

base, weakly projecting, cubitus (*M*) absent, *Rs*₂ almost straight, venation very pale, surface of wing dotted with spicules on apical half, hair fringe on apical margin short.

MATERIAL EXAMINED

Holotype ♀, **Zaire**: Samkuru, Gandajika, 5.iii.1948 (*P. Henrard*) (MRAC, Tervuren).

Zaire: 2 ♀, 2 ♂, same data as holotype (all parasites of larvae of *Paragus borbonicus* Macquart (Syrphidae) (MRAC, Tervuren).

Prosaspicera tropica (Kieffer)

(Fig. 58)

Aspicera tropica Kieffer, 1910c : 20. Holotype ♂, MALAWI (MNHU, Berlin) [examined].

Prosaspicera tropica (Kieffer) Weld, 1952 : 167.

DESCRIPTION. ♂. Antenna 14-segmented. SN 3-5=AR 14:13:12. Segment 3 swollen medially, 4-13 moniliform, subequal in length, 14 longer than 13. Head viewed frontally arcuate on vertex, inner orbits of face with radiating striae (Fig. 58), face above clypeus densely pubescent, occipital carinae distinct, vertex crenulate (Fig. 58). Pronotum angled on dorsal margin with a coriaceous pronotal plate, sides of pronotum coriaceous and slightly pubescent. Surface of mesocutum coriaceous, median scutal line distinct, in form of a wide deep coriaceous triangular area apically, its side margins bordered by the inner margins of the notaulices, notaulices wide at apex, crenulate, anterior parallel lines pronounced, extending to a point midway on the mesoscutum, lateral lines almost complete; scutellar foveae separated by carinae, each fovea with a longitudinal carina extending to and along the scutellar spine, scutellar spine viewed dorsally reaching as far as margin of segment 3 of gaster viewed dorsally; propodeum carina not obvious. Mesopleural suture distinct, area above and below suture reticulate-coriaceous. Segment 1 of gaster not visible. Segment 2 liguliform, segment 3 the largest, viewed laterally the apical two-thirds strongly punctured, remaining segments not visible. Hind tibia with longitudinal ridges. Radial cell of forewing open at base and on wing margin, vein *m* indicated as a short spur. Colour: head and thorax black, gaster chestnut-brown to black, antenna and legs orange-yellow.

♀ unknown.

MATERIAL EXAMINED

Holotype ♂, **Malawi**: Nyassa-See, Langenburg, vi-vii. 1898 (*S. Füllehorn*) (MNHU, Berlin).

OBERTHUERELLINAE Kieffer

Oberthuerellinae Kieffer, 1903 : 88. Type-genus: *Oberthuerella* Saussure.

Segment 5 of gaster the largest, preceded by three short segments (Fig. 2). Scutellum more usually with a spine on the apical margin. Hind femur with a distinct tooth on the underside (Fig. 11).

DISCUSSION. The Oberthuerellinae was treated as one of three subfamilies in the Liopteridae by Hedicke & Kerrich (1940) and again by Weld (1952). It is closely related to the Mesocynipinae but distinguished from it by a conspicuous tooth or spine on the underside of the hind femur and the scutellum invariably has a distinct medial spine at the apex with a tooth or spine on either side. It is separated from the Liopterinae by the gaster being attached normally at an angle (Fig. 2). The Oberthuerellinae are not known to occur outside the Ethiopian Region and comprise three genera, *Oberthuerella* Saussure, *Tessmannella* Hedicke and the monotypic *Xenocynips* Kieffer. Twelve species of *Oberthuerella*, including two newly described here, are at present recognised. Of the twelve, two are omitted from the key to species either because the syntype-material is lost or the type-depository is not known. Only four species of *Tessmannella* are known, including one described in this paper. Hedicke (1912a) separated *Tessmannella* and *Xenocynips* from *Oberthuerella* on the median dorsal tooth of the pronotum being present in both but completely absent in *Oberthuerella*. *Xenocynips* was erected by Kieffer (1910) and is separated from *Oberthuerella* and *Tessmannella* by segments 2-4 of the gaster being fused.

Key to genera of Oberthuerellinae

- 1 Pronotum without a median dorsal tooth on hind margin; propodeum with pronounced side margins in the form of flaps, strongly sculptured (Fig. 117); tooth on hind femur almost erect (Fig. 11); segment 1 of gaster sulcate, at most twice as long as broad, almost rectangular (Fig. 114) **OBERTHUERELLA** Saussure (p. 110)
- Pronotum viewed laterally with a median dorsal tooth on hind margin anterior of mesoscutum (Fig. 116), propodeum without pronounced side margins (Fig. 115); angle of tooth on hind femur variable; segment 1 of gaster variable in length 2
- 2 Tergites 2, 3 and 4 short, 5 the largest; hind femur with a rounded lobe between medial area and apex, tooth angled, not erect (Fig. 109); segment 1 of gaster at least three times as long as broad, petiolate (Fig. 120); hind tibia with distinct lobe opposite the two tibial spines apically; scutellar foveae three in number **TESSMANNELLA** Hedicke (p. 116)
- Tergites 2-4 fused without trace of suture (Fig. 32); hind femur without a rounded lobe at apex, tooth between medial area and apex erect (Fig. 111); segment 1 of gaster sulcate, less than three times as long as broad, almost rectangular; hind tibia without a distinct lobe apically; scutellar foveae obscure (Fig. 110) **XENOCYNIPS** Kieffer (p. 118)

OBERTHUERELLA Saussure

Oberthuerella Saussure, 1890 : 20, pl. 20. Type-species: *Oberthuerella lenticularis* Saussure, by monotypy.

DIAGNOSIS. ♀ antenna 13-segmented, clavate; ♂ antenna 14-segmented. Face viewed frontally reticulate to rugose with a frontal line or keel extending from anterior ocellus to clypeus in most species, eyes further apart than the height of an eye viewed frontally. Pronotum sculptured without a median tooth on hind margin. Mesoscutum variously sculptured, scutellum apically tridentate the median tooth generally in the form of a long spine except in *triformis*, base of scutellum with a variable number of between 2 and 4 foveae each separated by a longitudinal carina. Segment 1 of gaster (petiole) sulcate, variable in length, segments 2-4 each short, 5 the largest in lateral view. Hind femur with erect tooth.

DISTRIBUTION. Cameroun; Madagascar; Nigeria; Zaire.

DISCUSSION. The original publication contained only the name and a figure. Kieffer (1903 : 88), however, gave an extended description of *lenticularis*. Weld (1952) stated 'that a female in Paris collected by Alluaud in 1901 in Madagascar may be the type of *lenticularis* Sauss'. To this specimen Weld added his determination label '*Oberthuerella lenticularis* Sauss. det. Weld 1931'. This specimen cannot be a syntype because Saussure's original figure of *lenticularis* was published in 1890. The specimen determined by Weld agrees in detail with Kieffer's description and with the figure of *lenticularis* illustrated by Saussure (1890). I have examined a specimen standing under *lenticularis* in Geneva labelled 'Typus' and 'Madagasc'; it is a male and therefore cannot be the type figured by Saussure (1890) or the specimen described as *lenticularis* by Kieffer (1903).

Key to species of *Oberthuerella* Saussure

- 1 Frontal line in form of a keel or crest running from median ocellus to clypeus through rugose sculpture; gaster viewed laterally generally with conspicuous hairs on segments 2-5 viewed dorsally with or without long golden pubescence; ♀ with weak apical hair fringe on segments 5 and 6 viewed laterally 2
- Frontal line not present, face entirely reticulate-rugose; gaster viewed dorsally without conspicuous hairs on the segments; ♀ with sparse hairs and apical fringe sometimes present on segments 5-7 8
- 2 Tergites 2-5 of gaster viewed dorsally with dense long golden pubescence. Segment 1 of gaster at least as broad as long (Fig. 119); areolet absent. (♂ unknown) **aureopilosa** Benoit (p. 112)
- Tergites 2-3 of gaster viewed dorsally without pubescence, 4-5 with fine pubescence or bare (Fig. 120); areolet present or absent 3
- 3 Apical margin of tergite 4 of gaster almost straight medially (Fig. 120); segment 1 of gaster longer than broad. 5
- Areolet absent 5
- Apical margin of tergite 4 of gaster strongly arcuate medially (Figs 121, 127), segment 1 of gaster either longer than broad or as broad as long 4

- 4 Segment 5 of gaster viewed dorsally with long scattered pubescence; first cubital cell of forewing closed, areolet distinct though sometimes weakly indicated (Fig. 122) 6
- Segment 5 of gaster viewed dorsally without long scattered pubescence; first cubital of forewing open, areolet absent (Fig. 123) 7
- 5 Pronotum distinctly striated; scutellar spine short, viewed dorsally not extending one-fourth of the length of segment 1 of gaster, segment 5 of gaster viewed laterally shiny with fine scattered punctures, segments 5 and 6 with apical hair fringe; fore and mid legs black, hind coxae dark chestnut, femur and tibia yellow, tarsi reddish black. (♂ unknown) *breviscutellaris* Benoit (p. 112)
- Pronotum reticulate-rugose; scutellar spine long, viewed dorsally extending complete length of segment 1 of gaster in male, short in female; segment 5 of gaster viewed laterally closely and densely punctate, dull with long scattered hairs on dorsal surface (Fig. 126); fore, mid and hind legs reddish yellow *longispinosa* Benoit (p. 114)
- 6 Pronotum reticulate-rugose; gaster and legs orange-yellow, segments 5–7 of gaster with fine scattered pubescence on upper lateral surface, lower lateral surface very finely punctate; forewing with areolet very weakly indicated, first cubital cell appearing closed basally (Fig. 122). (♂ unknown) *crassicornis* Benoit (p. 112)
- Pronotum punctate-reticulate (the punctures widely spaced); gaster and legs chestnut-brown, segments 5–7 of gaster with long golden scattered pubescence on upper lateral surface, lower lateral surface strongly punctate; forewing with areolet distinct, first cubital cell closed (Fig. 124). (♂ unknown) *nigrescens* Benoit (p. 115)
- 7 Frontal line in form of a sharp keel, narrow; segment 3 of antenna shorter than 4 in both sexes; segment 1 of gaster longer than broad, black *abscinda* sp. n. (p. 111)
- Frontal line not sharp, raised and broadened apically, obscured by sculpture; segments 3 and 4 of antenna subequal; segment 1 of gaster as broad as long, chestnut-brown. (♂ unknown) *longicaudata* Benoit (p. 114)
- 8 Forewing with a distinct areolet, first cubital cell closed (Fig. 128); scutellar spine long, viewed dorsally extending well past middle of segment 1 of gaster; pronotum and mesoscutum coarsely reticulate rugose; legs entirely yellow *lenticularis* Saussure (p. 113)
- Forewing without an areolet, first cubital cell closed; scutellum tridentate but without a spine medially (Fig. 125); pronotum and mesoscutum aciculate; fore and mid legs reddish black, hind femur and tibia reddish yellow. (♂ unknown) *triformis* sp. n. (p. 115)

Oberthuerella abscinda sp. n.

DESCRIPTION. ♀. Antenna 13-segmented, clavate, segment 3 shorter than 4. SN 3–13 = AR 17: 23: 18: 20: 15: 17: 14: 14: 12: 12: 20, segments 5–13 each progressively thicker than preceding segment. ♂. Antenna 14-segmented, segment 4 twice the length of 3, 5 longer than 3, shorter than 4, remainder subequal to 5. Face viewed frontally reticulate-rugose with a distinct frontal line or keel extending from anterior ocellus to clypeus, eyes further apart than height of an eye, cheeks converging sharply. Pronotum and mesoscutum reticulate-rugose viewed dorsally. Notaulices submerged in coarse reticulate sculpture. Scutellum with 3–4 irregular foveae at base, apical margin tridentate with the median tooth in form of a distinct spine. Propodeum viewed posteriorly, angular, carina of propodeum weakly bowed with transverse canaliculate sculpture either side. Mesopleura with strigose sculpture on a polished surface. Segment 1 of gaster sulcate, longer than broad, gaster viewed dorsally without pubescence, segment 4 of gaster arcuate medially; hypopygium protruding, ventral spine short. Legs black, hind femur with erect spine between middle and apex, punctate; hind tibia foveolate-reticulate on outer margins, inner margins with longitudinal carinae. Wings infusate, densely ciliate on the surface, margins bare, radial cell of forewing closed, first cubital cell open, second cubital cell absent (areolet), cubitus almost reaching apex of wing. Colour: antenna, head, segment 1 of gaster (petiole) and legs black; gaster yellow.

MATERIAL EXAMINED

Holotype ♀, **Zambia**: Mbala ('Abercorn'), 31.xii.1943 (BMNH).

Paratypes. **Zambia**: 1 ♂, same data as holotype (BMNH). **Zaire**: Eala, xii.1932 (*A. Corbiser*) (MRAC, Tervuren).

REMARKS. This species is in the group with a frontal line present on the face but lacks long scattered pubescence on the gaster. Segment 3 of the antenna is shorter than 4 in both sexes, thus separating it from *longicaudata*.

Oberthuerella aureopilosa Benoit

(Fig. 119)

Oberthuerella aureopilosa Benoit, 1955 : 290. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antennae 13-segmented (only basal three segments of type present, five median segments mounted on card point). Face viewed frontally with a pronounced median carina, extending to median ocellus, surface reticulate-rugose with fine pubescence, cheeks not sharply converging. Pronotum and mesoscutum with broken transverse reticulate-rugose sculpture, median scutal line complete and distinct, notaulices distinct. Scutellum coarsely reticulate-rugose with long apical spine medially, lateral bars extended at apex to form short spines, scutellar foveae canaliculate. Propodeum angular viewed from behind, sculpture obscured by dense pubescence; mesopleura with strigose sculpture on upper half, polished on lower half. Segment 1 of gaster viewed dorsally slightly broader than long, crenulate, gastral segments 2–5 on dorsal surface with long golden pubescence on a foveolate-reticulate surface, viewed laterally apical half of segment 5 pubescent, remaining visible segment pubescent, hypopygium not protruding, apical sternite produced, apical margin with long setae, ventral spine short. Legs dark chestnut-red, tarsi black, hind femur with perpendicular spine between middle and apex, hind tibia polished, with widely spaced foveolae, inner side with a longitudinal carinae. Wings infusate, densely ciliate on surface, margins bare, radial cell of forewing closed, first cubital cell closed, 2nd cubital (areolet) not indicated, cubitus almost reaching apex of wing. Colour: antenna, head, thorax, segment 1 of gaster with black and brown crenulations, gaster orange-red.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, Zaire: Maniema, Kindu, xi.1973 (*L. Burgeon*) (MRAC, Tervuren).*Oberthuerella breviscutellaris* Benoit

(Fig. 120)

Oberthuerella breviscutellaris Benoit, 1955 : 286. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antennae 13-segmented, subclavate, segment 3 shorter than 4, 4 shorter than 5, 6 shorter than 5, subequal to 7, 8–13 subequal in length, 8–12 as wide as long, 13 longer than wide. SN 3–13 = AR 10 : 12 : 15 : 12 : 11 : 10 : 8 : 8 : 8 : 14. Face viewed frontally with coarse reticulate sculpture, striate in region of clypeus and cheeks, median area in form of a crest viewed laterally, eyes further apart than height of an eye, cheeks converging sharply. Pronotum transversely striate dorsally. Mesoscutum with coarse transverse ridge-like sculpture, notaulices crenulated, impressed, median scutal line absent. Scutellum with foveae at base (obscured in the holotype by the pin on which it is mounted being through the centre), sculpture large reticulate-rugose, apex of scutellum with medial spine spoon-shaped and lateral bars tooth-shaped apically. Propodeum viewed dorsally, foveolate. Mesopleura with diagonal striate sculpture, mesopleural triangle finely coriaceous. Segment 1 of gaster sulcate, longer than broad viewed dorsally (length 3·5, breadth 2·5) but broader apically than at base (Fig. 120). Tergites 2–4 short, tergite 4 of gaster as long as 3 + 4 (Fig. 120), 5 the longest, all segments with sparse punctures visible on the dorso-lateral margins, apex of 5, 6 and 7 with long setae, hypopygium distinct. Coxae and tibiae smooth and shining, tarsi dull, sculptured and pubescent, hind metatarsus longer than remaining segments combined, hind femur with distinct perpendicular tooth or spine. Wings entirely fuscous, forewing with radial cell completely closed, radial and first cubital cell darker, first cubital open, second cubital (areolet) not indicated, wing surface lightly ciliate, margins bare, cubitus almost reaching apex of wing. Colour: antenna, head, thorax, fore and mid legs black, hind coxae black, femur, tibiae and tarsi red, segment 1 of gaster black, remaining segments yellowish orange.

MATERIAL EXAMINED

Holotype ♀, Zaire: Lalua, Luashi, x.1938 (*F. Freyne*) (MRAC, Tervuren).Rhodesia: 1 ♀, Mt Chirinda, Gasaland (*Marshall*) (BMNH). Zaire: 1 ♀, Lubumbashi, 1.iii.1975 (*W. Beun*) (MRAC, Tervuren).*Oberthuerella crassicornis* Benoit

(Figs 121, 122, 127)

Oberthuerella crassicornis Benoit, 1955 : 289. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined].*Oberthuerella compressa* Benoit, 1955 : 292. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined]. **Syn. n.**

DESCRIPTION. ♀. Antenna 13-segmented, clavate. SN 3-13=AR 12:15:12:12:12:10:10:10:10:10:23, 5-12 each progressively thicker. Face viewed frontally reticulate-rugose, with a distinct frontal line or keel extending from median ocellus to clypeus, eyes further apart than height of an eye, strongly swollen in frontal view, cheeks converging, pronotum and mesoscutum foveolate to reticulate-rugose viewed dorsally, notaulices present, impressed in the sculpture, base of scutellum with three large foveae, median area reticulate-rugose, apex of scutellum tridentate, the medial spine viewed dorsally as long as segment 1 of gaster (petiole). Mesopleurae transversely strigose to rugose-foveolate anteriorly. Propodeum with parallel carinae and a transverse medial ridge. Segment 1 of gaster sulcate, viewed dorsally longer than wide, segment 2 of gaster viewed dorsally shorter than 1, 3 subequal to 2 (Fig. 127); apical margins straight medially, segment 4 longer measured medially than 2+3, apical margin arcuate, segment 5 the largest with scattered pubescence and strongly punctate in lateral view, apical margin of tergite 6 with a fringe of hairs, hypopygium short, not protruding. Legs orange-yellow, smooth and shining. Hind femur with suberect median spine; hind tibia weakly sculptured. Wing surface ciliate, margins bare, radial cell of forewing completely closed, cubitus extending almost to edge of wing, first cubital cell closed, areolet weakly indicated. Colour: antenna, head and thorax black, petiole black and red, gaster orange-red.

♂ unknown.

MATERIAL EXAMINED

Oberthuerella crassicornis Benoit, holotype ♀, **Zaire**: Tshuapa, Eala, vii. 1936 (*J. Ghesquière*) (MRAC, Tervuren). *Oberthuerella compressa* Benoit, holotype ♀, **Zaire**: dist. Lac Léopold II, Bena Bendi, v.1915 (*R. Mayne*) (MRAC, Tervuren).

Malawi: 1 ♀, Malanje, 24.iv.13 (*S. A. Neave*) (BMNH).

Oberthuerella lenticularis Saussure

(Figs 114, 117)

Oberthuerella lenticularis Saussure, 1890: pl. 20. Holotype ♀, **MADAGASCAR**: (? MHN, Geneva). (Holotype not found; description based on material determined by Weld, 1931.).

DESCRIPTION. ♀. Antenna 13-segmented, subclavate, segment 3 shorter than 4, 5-12 cylindrical, longer than broad, 13 subequal to 11+12. SN 3-13=AR 17:21:22:20:18:15:12:12:12:12:20. ♂. Antenna 14-segmented. SN 3-14=AR 10:17:15:15:15:13:13:13:13:13:13:20. Head viewed frontally with a median ridge extending from median ocellus to a point midway between antennal sockets, face and dorsal surface of head coarsely reticulate-rugose with scattered pubescence, face without a medial carina. Pronotum and mesoscutum shining, coarsely reticulate, median scutal line and notaulices obscure, impressed in the sculpture, centre of scutellum dishd with longitudinal carina within each of two foveae, apex of scutellum reticulate-rugose, ending in a smooth spine almost as long as breadth of scutellum, lateral bars extending at apex to form short spines. Propodeum angled either side of centre which is broad and crenulate (Fig. 117). Mesopleurae with strigose-reticulate sculpture on upper half, polished on lower half. Segment 1 of gaster viewed laterally as broad as long, crenulate (Fig. 114), segment 2 viewed dorsally short, 3 twice as long as 2, 4 as long as wide, 5 the longest, viewed laterally apex of tergite 4 with scattered setae, apex of 5 and 6 finely reticulate, hypopygium not protruding, ventral spine short. Petiole in ♂ longer than broad, segments 2 and 3 of gaster viewed dorsally of equal length, 4 twice length of 3. Legs orange-yellow, coxae and femur shiny, hind femur with distinct perpendicular tooth. Wings infusate, darker basally, surface finely ciliate, margins bare, radial cell of forewing completely closed, first cubital cell closed, second cubital (areolet) weakly indicated, cubitus almost reaching apical margin of wing (Fig. 128). Colour: antenna, head and thorax black, petiole and gaster orange-red.

MATERIAL EXAMINED

Madagascar: 1 ♀, Region du Sudest, Vallée du Fanjahira Isakam, xii.1901 (*Ch. Alluaud*) (MNHN, Paris); 1 ♀, 1 ♂, 1919 (*J. de Gaulle*) (MNHN, Paris); 1 ♀, ? Somlirano (*A. Seyrig*) (MNHN, Paris); 2 ♀, Fanovano, iii.34 (*A. Seyrig*) (MNHN, Paris); 1 ♀, Manara, x.1963 (*J. Vadon*) (MRAC, Tervuren); 1 ♀, Manguzi River, nr Maputa Z., xii.1945 (*H. Bell Marley*) (BMNH); 1 ♀, Ambodivoangy, xii.1961 (*J. Vadon*) (MRAC, Tervuren); 1 ♀, Fanpanambo, ii.1960 (*J. Vadon*) (MRAC, Tervuren); 1 ♀, same data except ii.1961 (MRAC, Tervuren); 1 ♀, Manara, 1963 (*J. Vadon*) (MRAC, Tervuren); ♀, Bekily, Reg. Sud De Lile, iii.1933 (*A. Seyrig*) (MNHN, Paris). **Malawi** (Nyasaland): Chiromo (*R. C. Wood*) (BMNH). **South Africa**: 1 ♀, Natal, Lake Sibayi, 13-24.iii.1968 (*D. J. Brothers*) (AM, Grahamstown).

Oberthuerella longicaudata Benoit

(Fig. 123)

Oberthuerella longicaudata Benoit, 1955 : 291. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antenna 13-segmented (apical three segments missing), subclavate, segments 3 and 4 subequal, 5 longer than 4, remaining segments gradually decreasing in length. SN 3-10=AR 20 : 20 : 22 : 19 : 18 : 18 : 18 : 18. Face with reticulate-rugose sculpture and fine scattered pubescence, medial carina extending to median ocellus. Pronotum viewed dorsally foveolate, mesoscutum with transversely wrinkled reticulate-rugose surface, notaulices distinct but submerged in the surface sculpture. Scutellum coarsely foveolate with five canaliculate foveae at base, median apical spine short, equal to apical width of scutellum, lateral bars produced to form weak spines on either side of medial spine. Propodeum angular on side margins, weakly pubescent, carinae bowed with foveolae within medial area. Mesopleurae with transversely striate sculpture on upper half, lower half polished. Segment 1 of gaster viewed dorsally broader than long, crenulate, segment 2 slightly shorter than 3, 3 longer than 2, 4 longer than 3, viewed laterally finely punctate, apical margins of 4, 5 and 6 with fringe of hairs, hypopygium short, not protruding, ventral spine short. Legs orange, hind femur with distinct perpendicular tooth, hind tibiae polished with widely spaced foveolae medially, hair fringe on margins weak. Wings infusate, surface ciliate, margins bare, radial cell of forewing closed, first cubital cell open, second cubital (areolet) not indicated, cubitus almost reaching apex of wing. Colour: antenna, head and thorax black, segment 1 of gaster mainly black, apex reddish, gaster orange-red.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, Zaire: Tshuapa, Eala, v.1935 (*J. Ghesquière*) (MRAC, Tervuren).*Oberthuerella longispinosa* Benoit

(Fig. 126)

Oberthuerella longispinosa Benoit, 1955 : 290. Holotype ♂, ZAIRE (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antenna 13-segmented. SN 3-13=AR 10 : 11 : 14 : 13 : 12 : 10 : 10 : 8 : 8 : 13. ♂. Antenna 14-segmented, subclavate, segment 3 shorter than 4, 4 longer than 5, 5 and 6 subequal, 7-13 subequal, each shorter than 6, 14 shorter than 12+13. SN 3-14=AR 13 : 20 : 18 : 18 : 16 : 16 : 16 : 15 : 15 : 15 : 26. Face with median carina extending to median ocellus, surface rugose-reticulate with fine sparse pubescence and strigose sculpture medially. Pronotum and mesoscutum coarsely reticulate-rugose, median scutal line obsolete, visible apically, notaulices submerged in surface sculpture but distinct. Scutellum coarsely reticulate-rugose with median apical spine as long as apical width of scutellum, lateral bars in form of spines at apex, scutellar foveae canaliculate, five in number. Propodeum angular viewed from behind, carinae parallel on sculptured surface, pubescent on side margins only. Mesopleura with canaliculate sculpture on upper surface, polished below. Segment 1 of gaster longer than broad, sulcate, segment 2 viewed dorsally shorter than 3, 3 shorter than 4, 5 largest with long scattered hairs, viewed laterally segment 5 with fine dense punctures. Legs completely orange-red, hind femur with distinct perpendicular tooth, hind tibia coarsely reticulate and pubescent on the outer margins, inner side with a longitudinal carina. Wings infusate, surface ciliate, margins bare, radial cell of forewing completely closed, first cubital cell appearing open (venation not indicated), second cubital (areolet) absent, cubitus extending past middle of wing. Colour: antenna, head and thorax black, segment 1 of gaster chestnut-red, remaining segments orange-red.

MATERIAL EXAMINED

Holotype ♂, Zaire: Iles des Elephants (en aval de Roma), 30.xi.1939 (*H. J. Bredo*) (MRAC, Tervuren).

Gabon: 1 ♀, 'Congo Franc', Ogooue N'kogo, 1901 (*J. Bouysson*) (MNHN, Paris); 1 ♀, Ogooue, Lambarene, 1912 (*R. Ellenberger*) (MRAC, Tervuren). Ivory Coast: 1 ♀, Andé Bongouuno, iii.1962 (*J. Decelle*) (MRAC, Tervuren). Malawi: 1 ♂, Ruw Valley, 2000 ft [600 m], 14.xii.1913 (*S. A. Neave*) (BMNH).

Oberthuerella nigra Kieffer*Oberthuerella nigra* Kieffer, 1910 : 110. Holotype ♂, EQUATORIAL GUINEA ('Spanish Guinea') (originally in MNHU, Berlin, now missing).

I have not included this species in the key as the taxonomic characters used by Weld (1952) and Benoit (1955) are based on colour only. Neither author appears to have seen the type-material, which is now missing.

Oberthuerella nigrescens Benoit

(Fig. 124)

Oberthuerella nigrescens Benoit, 1955 : 288. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined].

DESCRIPTION. ♀. Antennae 13-segmented, subclavate, SN 1–13 = AR 22 : 7 : 25 : 26 : 24 : 20 : 17 : 17 : 16 : 16 : 14 : 13 : 20. Face viewed frontally coarsely reticulate-rugose with fine scattered pubescence, median carina extending to median ocellus, eyes viewed frontally further apart than the height of an eye, cheeks weakly converging, head viewed dorsally reticulate-rugose either side of lateral ocelli, weak striae medially. Pronotum dorsally scaly-reticulate with interspaces as big as the reticulate areas. Mesoscutum coarsely reticulate-rugose, median scutal line obsolete, notaulices distinct though submerged in surface sculpture of mesoscutum. Scutellum with canaliculate foveae at base, apex of scutellum with a distinct medial spine as long as apical width of scutellum, smooth and polished, medial area of scutellum coarsely reticulate-rugose, lateral bars of scutellum produced apically to form weak spines either side of median spine. Propodeum with distinct carinae medially and wide flanged-shaped areas on either side. Mesopleurae with reticulate-rugose sculpture in upper half, lower half mainly polished with broken reticulate outer margins. Segment 1 of gaster viewed dorsally slightly longer than broad, sulcate, segment 2 viewed dorsally one-third as long as segment 3, 3 half as long as 4, apical margin of segment 2 reflexed inward, side margins of tergites 2 and 3 with fine short scattered pubescence, tergite 5 the largest viewed laterally with fine scattered punctures in median basal area, long scattered pubescence anteriorly on apical region and dense small punctures in basal apical area, tergites 5 and 6 densely punctate with scattered long hairs, hypopygium short, not protruding, ventral spine short. Hind femur with a suberect median tooth or spine, hind femur coarsely foveolate-reticulate with comb of hairs on margin and a distinct longitudinal carina medially on inner side. Wings infusate, surface ciliate, margin of wing bare, radial cell of forewing completely closed, cubitus almost reaching apex of wing, first cubital cell closed, second cubital (areolet) complete, closed (Fig. 124). Colour: antenna, head, thorax and segment 1 of gaster (petiole) black, remaining segments dark chestnut-brown, legs dark brown.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, Zaire: Tshuapa, Eala, ix.1935 (*J. Ghesquière*) (MRAC, Tervuren).

Oberthuerella tibialis Kieffer

Oberthuerella tibialis Kieffer, 1904 : 107. Holotype ♀, CAMEROUN (? depository) [not examined].

The whereabouts of the holotype of this species is not known. Benoit (1955) includes it in his key but gives no indication as to whether he examined the type-material.

Oberthuerella triformis sp. n.

(Fig. 125)

DESCRIPTION. ♀. Antenna 13-segmented, subclavate, SN 3–13 = AR 15 : 15 : 20 : 15 : 12 : 12 : 10 : 8 : 8 : 8 : 10, segments 5–13 each very slightly broader than preceding one, segment 5 the largest. Face viewed frontally transversely strigose medially, reticulate-rugose laterally, frontal line or keel not apparent, eyes further apart than the height of an eye, cheeks weakly converging. Pronotum and mesoscutum transversely aciculate, notaulices submerged in the transverse sculpture. Scutellum with five foveae at base, medially reticulate-rugose, tridentate apically, the medial tooth not in the form of a spine. Propodeum viewed posteriorly, angular, carinae of propodeum bowed, surface coarsely reticulate-rugose. Mesopleura with strigose sculpture in part, smooth on lower half. Segment 1 of gaster longer than broad, sulcate, segment 4 of gaster arcuate viewed dorsally, segment 5 the largest viewed laterally, segments 5–7 of gaster viewed laterally with a distinct apical fringe, hypopygium not protruding, ventral spine short. Fore and mid legs reddish black, hind coxa and femur reddish yellow, tarsi black, hind femur with erect spine between median area and apex, impunctate, hind tibia smooth and shining on outer margins, inner margins with weak longitudinal carinae. Wings infusate, densely ciliate on surface, margins bare,

radial cell closed, first cubital cell closed, second cubital (areolet) absent, cubitus almost reaching apex of wing. Colour: antenna, head, thorax and segment 1 of gaster (petiole) black, gaster reddish yellow, fore and mid legs reddish brown, hind coxae black, femur and tibia reddish yellow, tarsi blackish.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, **Tanzania** ('Tanganyika'): Mshughaa, 30 miles [48 km] east of Singida, xii.1935–i.1936 (*E. Burt*) (BMNH).

REMARKS. Distinguished from all other species in the genus by the absence of a long distinctive scutellar spine (see Fig. 125).

TESSMANNELLA Hedicke

Tessmannella Hedicke, 1912a : 303. Type-species: *Tessmannella spinosa* Hedicke, by original designation

DIAGNOSIS. ♀ antenna 13-segmented, subclavate; ♂ antenna 14-segmented. Face with reticulate to rugose sculpture and scattered pubescence. Pronotum coarsely rugose with median tooth or spine viewed laterally. Mesonotum with coarse variable sculpture, propodeum without pronounced side margins. Segment 1 of gaster (petiole) three times as long as broad, segments 2–4 short viewed laterally and dorsally, segment 5 the largest. Hind femur with a rounded lobe between medial area and apex, tooth on hind femur angled, hind tibia with a distinct lobe apically, opposite the tibial spines, scutellar foveae three in number.

DISTRIBUTION. Gabon; Zaire.

DISCUSSION. Only four species are at present known in this genus, including one described for the first time in this paper. Hedicke (1912a) separated *Tessmannella* from *Oberthuerella* by the presence of a median tooth on the pronotum and by the spine on the hind coxae being obliquely angled.

Biology unknown.

Key to species of *Tessmannella* Hedicke

- 1 Forewing infusate medially, with distinctive light-coloured area basally and medially in the cubital cell (Fig. 108). (♀ unknown) *transiens* Benoit (p. 118)
- Forewings completely infusate 2
- 2 Scutellar foveae either angular or rounded apically, not extending past the middle of lateral bars (Fig. 106), legs red except for black hind tibia 3
- Scutellar foveae extending past middle of lateral bars, triangular apically (Fig. 105); fore and mid legs dark chestnut-brown, hind legs entirely black. (♂ unknown) *nigra* Hedicke (p. 117)
- 3 Notaulices obscured by strong crenulations along whole length; scutellar foveae angled at apex; facial cheeks converging weakly towards clypeus (Fig. 104), face rounded medially, weakly pubescent, clypeus with transverse striations, mandibles with lobed teeth; hind tarsi red; lateral bars (outer apical spines of scutellum) parallel. (♂ unknown) . *spinosa* Hedicke (p. 117)
- Notaulices broad basally, not obscured by crenulations, weakly crenulate at base, mainly shiny, scutellar spine long and narrow at apex, foveae rounded at apex (Fig. 106), facial cheeks strongly converging towards clypeus, face flattened medially, pubescent, mandibles with incised teeth, hind tarsi black, lateral bars of scutellum acutely angled. (♂ unknown) *expansa* sp. n. (p. 116)

Tessmannella expansa sp. n.

(Figs 106, 107, 118)

DESCRIPTION. ♀. Antenna 13-segmented, subclavate. SN 3–13 = AR 22 : 38 : 36 : 35 : 28 : 26 : 24 : 22 : 22 : 20 : 35. Face with irregular reticulate sculpture with long hairs issuing at base of each reticulation, mandibles with basal tooth blunt, incision deep, clypeus with weak coriaceous sculpture, eyes less than twice as far apart as height of eye viewed frontally, equal to length of malar space, cheeks weakly converging towards clypeus. Pronotum viewed laterally with median tooth or spine, frontal surface coriaceous, sides reticulate-rugose. Mesoscutum with broken widely spaced transverse sculpture, notaulices impressed on the surface sculpture and wide, median scutal furrow indicated by a depression, obscured by the transverse sculpture. Scutellum with three foveae at base, apex of scutellum with median spine and lateral

bars extended to form striate spines either side of median spine, surface of scutellum with irregular rugose sculpture. Mesopleurae with canaliculate sculpture on upper half and long hairs on a weakly reticulate polished surface on lower half. Propodeum sulcate at apex. Segment 1 of gaster sulcate, 3.5 times as long as broad, tergites 2–4 short, tergite 5 the largest, apex of tergite 5 and remaining visible tergites with long scattered hairs and dense punctures interspaced between the hairs, ovipositor sheath with dense hairs on the lower margins. Hind femur with a distinct tooth on inner margin which is directed backwards almost in same plane as femur, apex of femur emarginated (Fig. 129), hind tibia with reticulate-strigose sculpture and long hairs or spines, apex of hind tibia with a distinct lobe, tarsus 5-segmented with long hairs or spines on a reticulate surface. Radial cell of forewing completely closed, long and narrow, cubitus extending almost to edge of wing, wing surface ciliate, margin bare, whole wing infusate. Colour: antenna blackish brown, head reddish on face, blackish dorsally, thorax black, gaster chestnut-brown, all legs reddish brown except hind tibia and tarsi black.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, **Gabon**: Ogooue, Lambarene, 1910 (*R. Ellenberger*) (MNHN, Paris).

REMARKS. This species has close affinities with *spinosa* but is separated from it by a number of characters (see key).

Tessmannella nigra Hedicke

(Fig. 105)

Tessmannella nigra Hedicke, 1912a : 304. Holotype ♀, **ZAIRE** (MNHU, Berlin) [examined].

DESCRIPTION. ♀. Antenna 13-segmented, subclavate. Face with reticulate surface sculpture and fine white hairs issuing at base of reticulations, clypeus with very weak transverse striations, eyes further apart than height of eye, cheeks converging sharply towards clypeus viewed frontally. Pronotum viewed laterally with median tooth or spine, frontal surface polished, sides coarsely reticulate-rugose, mesoscutum appearing coarsely rugose with rugosity consisting of short transverse scales, notaulices and median scutal line impressed in the sculptured surface. Scutellum with three foveae at base, the outer two extending to apex of lateral bars which are finely striated and ending in a spine or tooth (Fig. 105), apex of scutellum with long median spine, surface of scutellum deeply rugose. Mesopleurae with canaliculate sculpture on upper half, lower half with long pubescence. Propodeum sulcate at apex. Segment 1 of gaster sulcate, three times as long as broad, tergites 2–4 short, tergite 5 the largest, apex of tergite 5 and remaining visible tergites with long scattered hairs and dense punctures interspaced between the hairs, ovipositor sheath with dense hairs on the lower margins. Hind femur with a distinct tooth on inner margin which is directed backwards almost in the same plane as femur, apex of femur rounded-emarginate (cf. Fig. 109), hind tibia with strong reticulate-canaliculate sculpture and long hairs, apex of hind tibia with a distinct lobe and two spines, tarsus 5-segmented with fine coriaceous sculpture. Radial cell of forewing completely closed, long and narrow, cubitus extending past middle of wing, surface of wing ciliate, margin bare, whole wing infusate. Colour: antenna black, head, thorax and gaster black, front legs dark brownish black on coxae and femur, mid and hind legs completely black.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, **Zaire**: Uelleburg, vi–viii.1908 (*von Tessmann*) (MNHU, Berlin).

Zaire: 1 ♀ Kibombo, 2.xi.1910 (*Bequaert*) (MRAC, Tervuren).

Tessmannella spinosa Hedicke

(Figs 103, 104)

Tessmannella spinosa Hedicke, 1912a : 303. Holotype ♀, **ZAIRE** (MNHU, Berlin) [examined].

DESCRIPTION. ♀. Antenna 13-segmented, subclavate. Face with reticulate surface sculpture and fine white hairs issuing at base of reticulations, clypeus with transverse striations, eyes further apart than height of eye viewed frontally, less than length of malar space, cheeks strongly rounded or curved, converging strongly towards clypeus (Fig. 104). Pronotum viewed laterally with a median tooth or spine (Fig. 116), frontal surface polished, sides coarsely sculptured. Mesoscutum coarsely reticulate-rugose with notaulices

and median scutal line impressed (Fig. 103), scutellum with spine at apex and shorter ones either side (Fig. 103), scutellum with three foveae at base, not extending to apex at lateral bars, surface of scutellum strongly reticulate-rugose. Mesopleurae with canaliculate sculpture on upper half, lower half shiny with scattered pits. Propodeum sulcate at apex. Segment 1 of gaster sulcate, almost four times as long as wide, tergites 2–4 short, tergite 5 the largest, apex of tergite 5 and remaining visible segments with fine light scattered hairs and dense punctures, ovipositor sheath with dense hairs on lower margin. Legs red except for hind tibia blackish, hind femur with a distinct tooth on inner margin which is directed backward almost in same plane, apex of femur with rounded lobe (cf. Fig. 109), hind tibia with reticulate-rugose sculpture with long hairs, tarsus 5-segmented with long hairs, apex of hind tibia with a distinct lobe and two spines. Radial cell of forewing completely closed, long and narrow, cubitus extending to past middle of wing, surface of wing ciliate, margin bare, whole wing infusate. Colour: antenna brownish black, head and thorax black, gaster chestnut-brown, front and mid legs reddish brown, hind femur and tarsi reddish brown, tibia blackish brown.

♂ unknown.

MATERIAL EXAMINED

Holotype ♀, **Zaire**: Uelleberg, vi–viii.1908 (von Tessman) (MNHU, Berlin).

Tessmannella transiens Benoit

(Figs 108, 116, 118)

Tessmannella transiens Benoit, 1955 : 283. Holotype ♂, **ZAIRE** (MRAC, Tervuren) [examined].

DESCRIPTION. ♂. Antenna 14-segmented, subclavate. Face with coarse reticulate sculpture and scattered pubescence, frontal line distinct, branching before reaching frontal area, occipital carinae pronounced, eyes further apart than height of eye, cheeks converging weakly. Pronotum viewed laterally with a median tooth or spine (Fig. 116), dorsal surface with coarse reticulate-rugose sculpture and foveolae. Mesonotum scaly-reticulate, notaulices impressed in surface sculpture, indistinct. Scutellum with three apical spines, scutellar foveae extending partly along lateral bars. Mesopleurae with canaliculate sculpture on upper half, lower half smooth with weak pits apically, propodeum sulcate. Segment 1 of gaster sulcate, four times as long as broad, tergites 2–4 short, viewed dorsally evenly curved (Fig. 118), tergite 5 the largest, viewed laterally densely punctate, apex of tergites 5 and remaining visible segments with long distinct scattered hairs. Legs black, hind femur with a distinct tooth on inner margin directed weakly towards apex, apex of femur with a distal lobe, hind tibia scaly-reticulate with long scattered hairs, apex of hind tibia with two spines and a distinct lobe, tarsus 5-segmented, surface sculpture fine reticulate. Radial cell of forewing completely closed, five times as long as broad, cubitus faint, extending almost to apex of wing, wing surface ciliate, margin bare, wing infusate medially to apex except for the medial area of the cubital cell.

Colour: completely black except for lower margins of basal segments of gaster which are chestnut-brown.

♀ unknown.

MATERIAL EXAMINED

Holotype ♂, **Zaire**: Ditri Tanganikam Albertville, 1–20.i.1919 (*R. Mayne*) (MRAC, Tervuren).

XENOCYNIPS Kieffer

Xenocynips Kieffer, 1910 : 340. Type-species: *Xenocynips subsquamata* Kieffer, by original designation and monotypy.

DIAGNOSIS. ♀. Antenna 13-segmented, claviform. Head and thorax strongly rugose. Scutellar foveae obscured by longitudinal carinae, scutellum reticulate-rugose, apex triangular. Pronotum viewed laterally with erect tooth or spine on hind margin anterior of mesoscutum (Fig. 32). Hind femur without a lobe distally, with an erect spine medially. Gaster with tergites 2–4 fused without trace of a suture (Fig. 32).

DISTRIBUTION. **Zaire**.

DISCUSSION. Only one species, based on a single specimen, has so far been placed in this genus. It differs from *Tessmannella* primarily by segments 2–4 of the gaster being fused and the spine on the hind coxae being erect. Weld (1952) suggested that at first appearance the size and shape of the gastral tergites could confuse it with the *Figitinae*.

Xenocynips subsquamata Kieffer

(Figs 32, 110, 111, 112, 113)

Xenocynips subsquamata Kieffer, 1910b : 340. Holotype ♀, CAMEROUN (IP, Eberswalde) [examined].

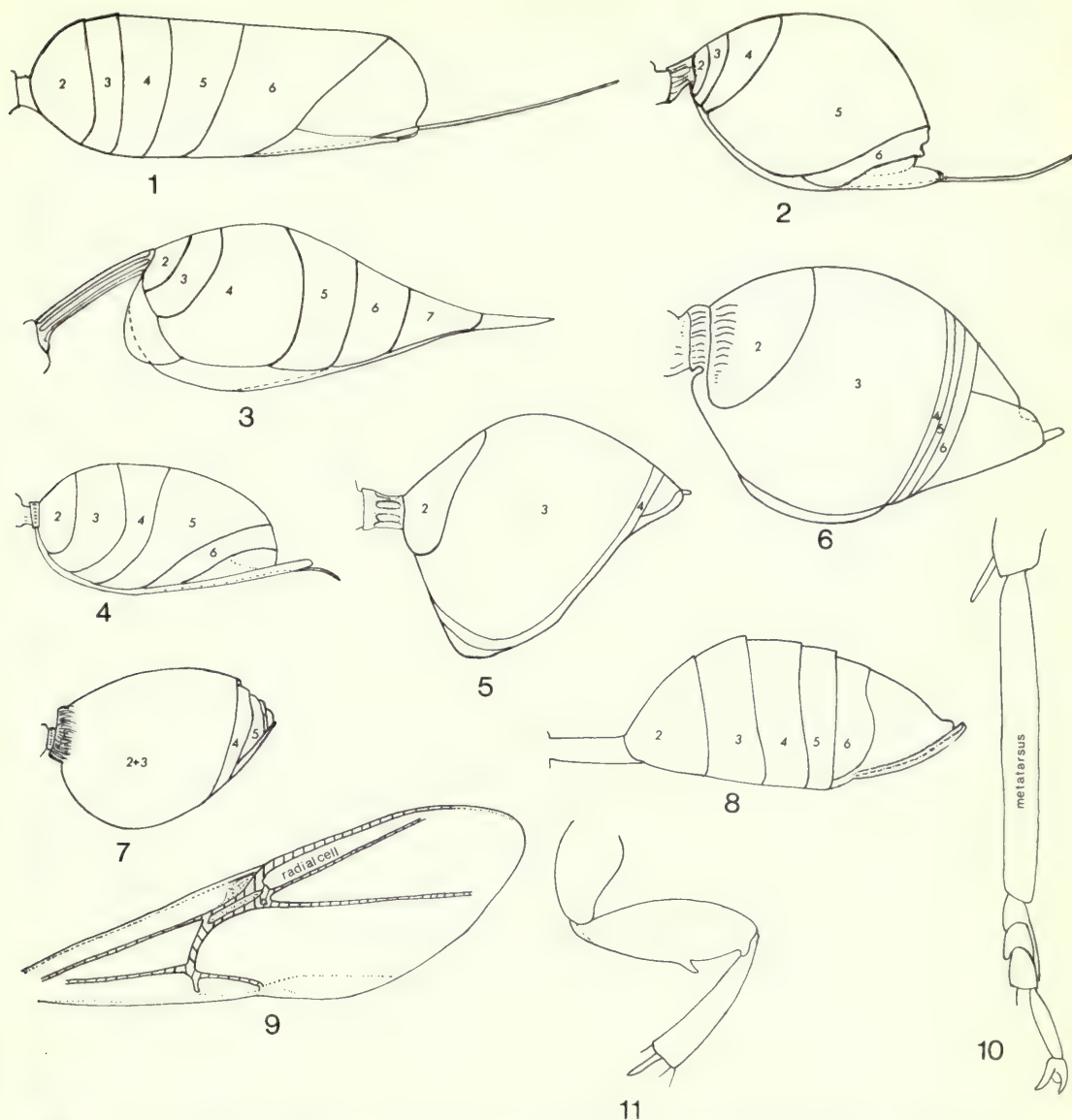
DESCRIPTION. ♀. Antenna 13-segmented, claviform, rhinaria on segments 4–13, segment 4 three times length of 3 (Fig. 112), basal segment brown, 2–8 yellowish, remainder brownish yellow. Head, pronotum and mesoscutum dorsally strongly rugose. Scutellar foveal depression obscured by longitudinal carinae, surface of scutellum reticulate-rugose, apex triangular, ending in conical protrusion; propodeum with parallel carinae. Pronotum viewed laterally with erect tooth on hind margin at anterior end of mesoscutum. Mesopleura polished with broken striate sculpture, fore and mid coxae yellowish brown, hind coxae blackish, elongate and swollen with scattered pubescence, hind femur with erect spine (Fig. 111), without a distal lobe. Segment 1 of gaster measured at extreme points less than three times as long as broad, crenulate, segment 2 of gaster small, fused with segments 3–4, segment 5 the largest with short regular hairs on apical half. Colour: antenna yellow basally, becoming darker towards apex, head and thorax black, gaster chestnut-red basally, brownish black on apical half, fore and mid legs yellowish, hind legs reddish brown on coxae and femur, tibia and tarsi dark reddish brown. Forewings with scattered short pubescence, wing margin without an apical hair fringe, radial cell completely closed, long and narrow, 4.5 times as long as its widest point, with a brownish patch extending throughout cell and well below, vein *2rm* short, *M* (cubitus) weak, extending almost to wing margin (Fig. 113).

♂ unknown.

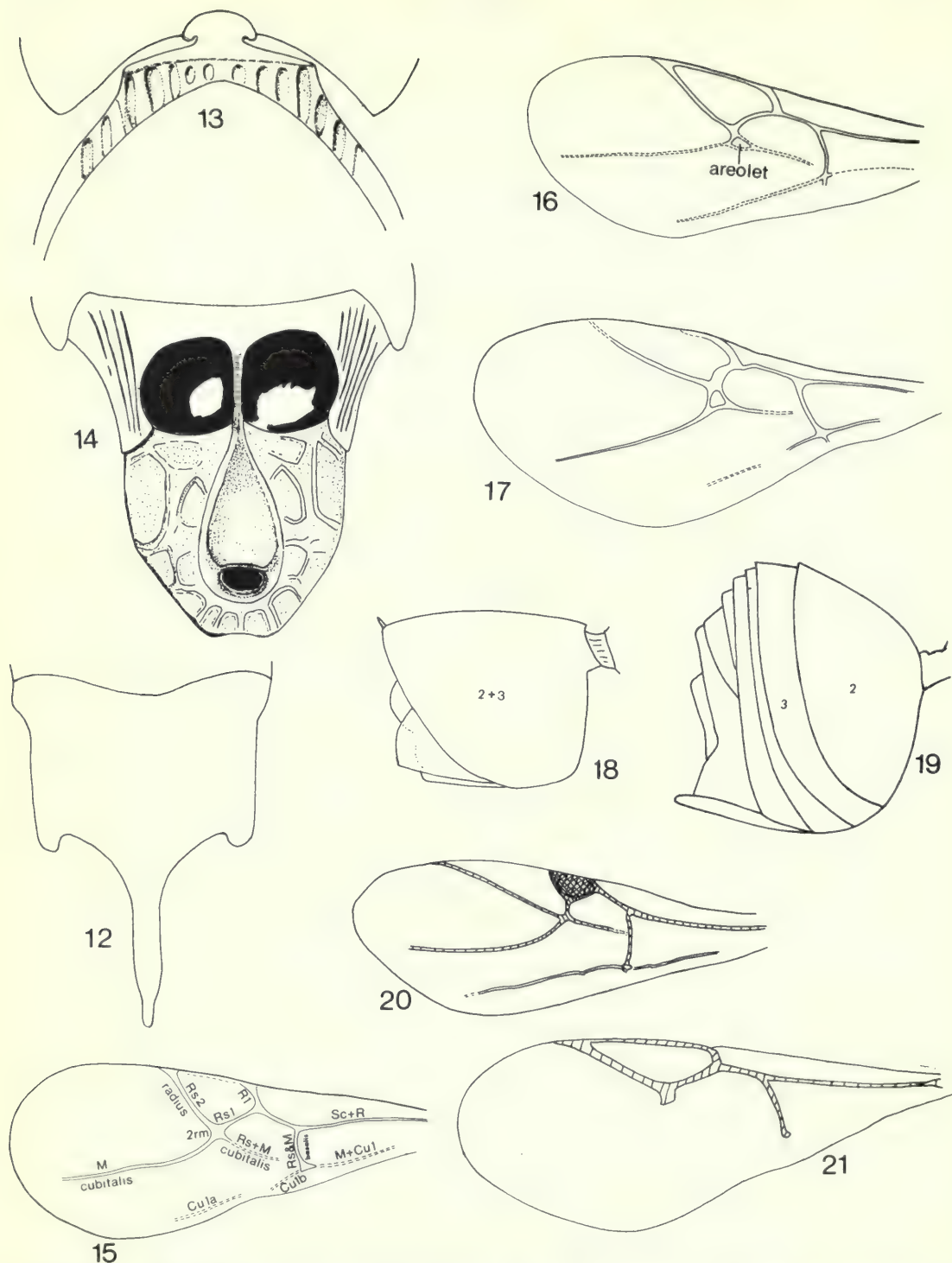
MATERIAL EXAMINEDHolotype ♀, **Cameroun** (Conradt) (IP, Eberswalde).**References**

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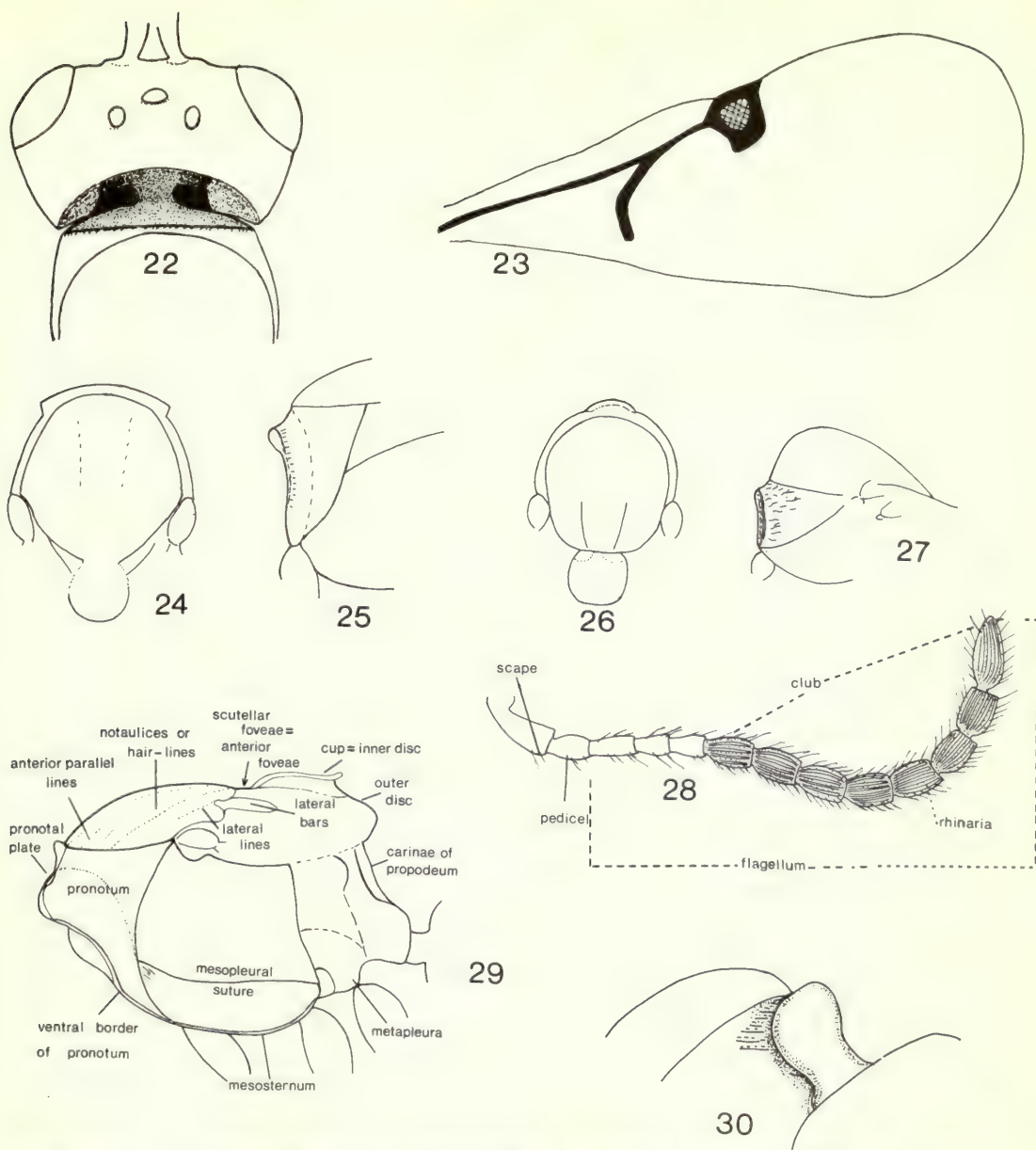
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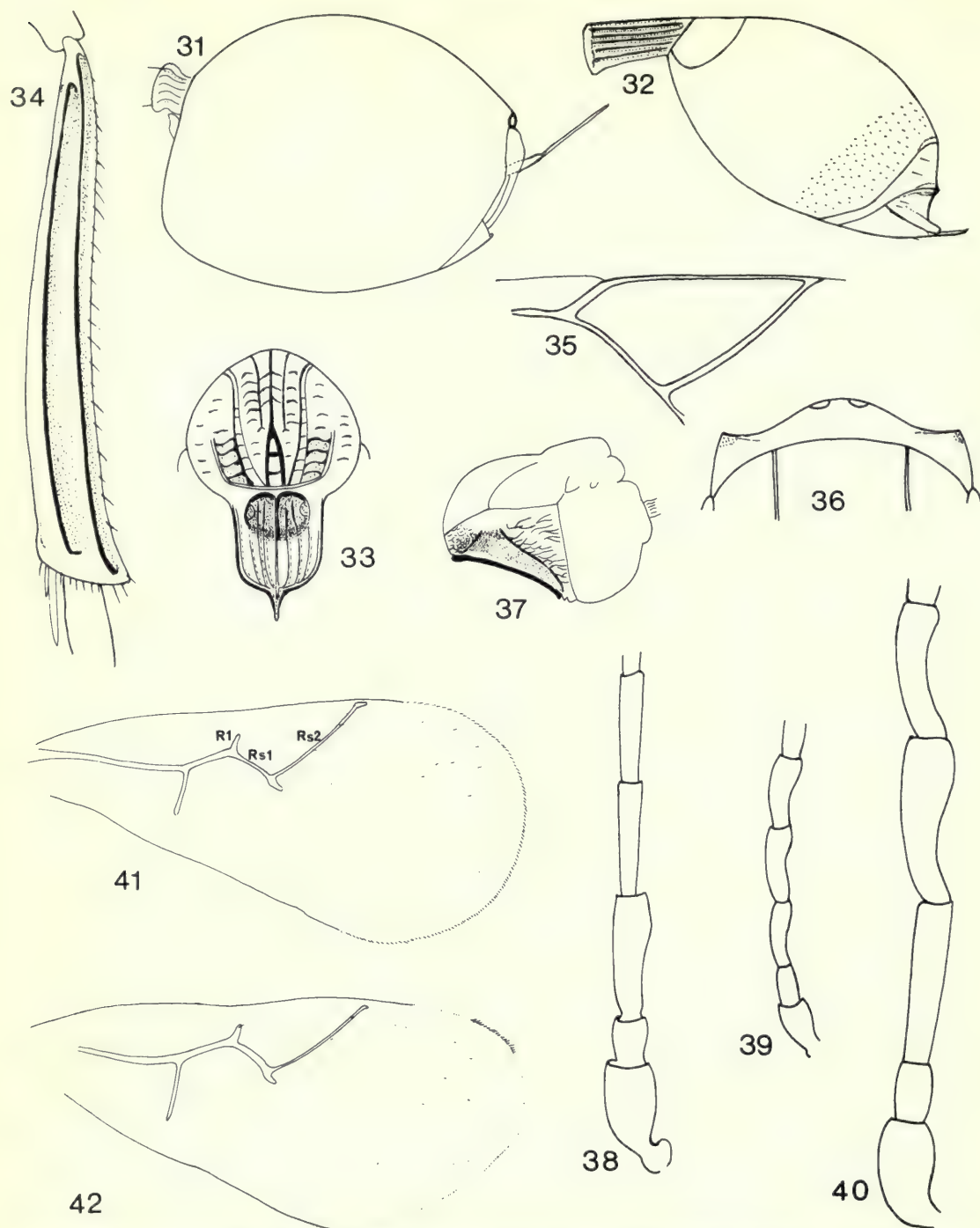
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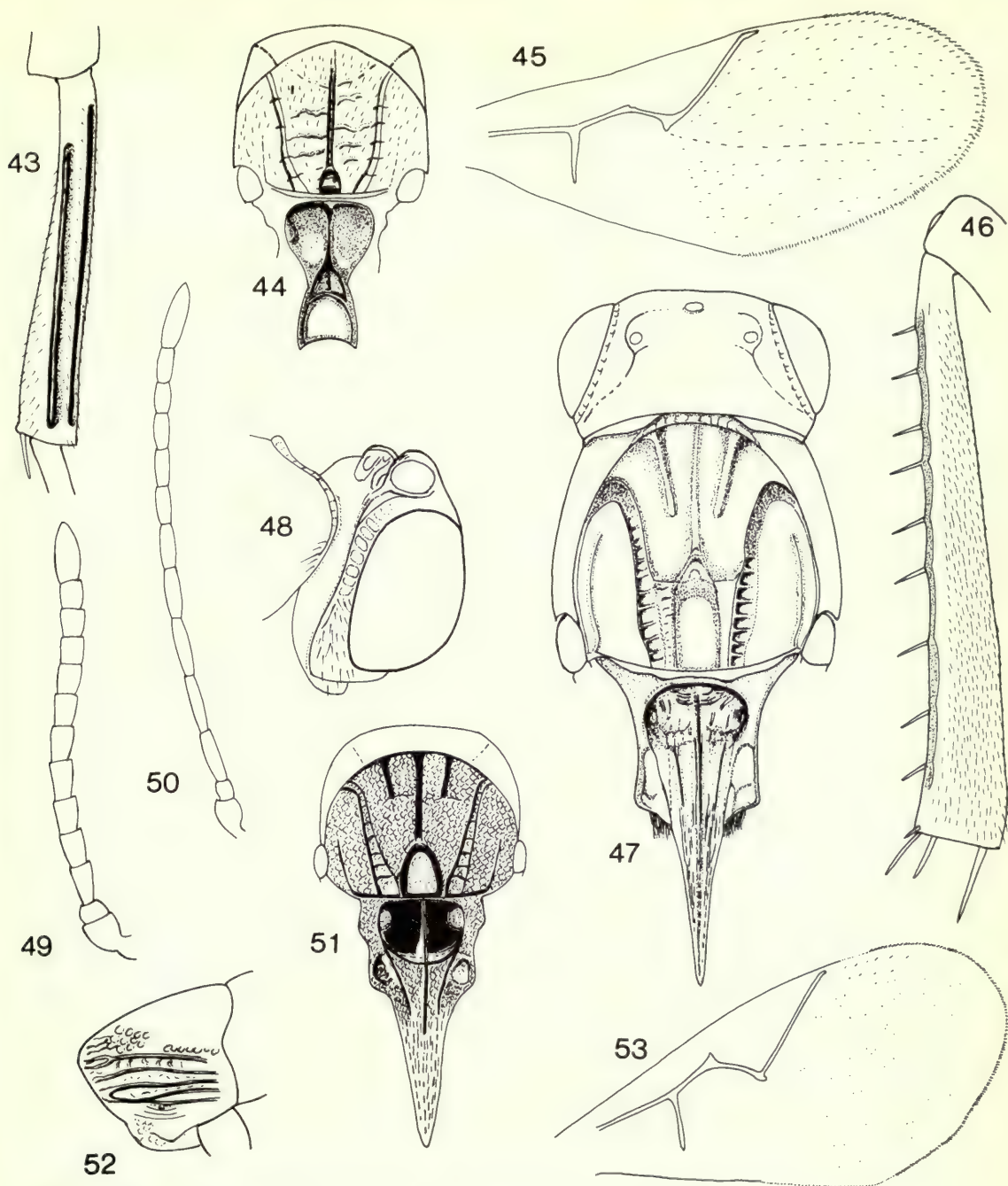
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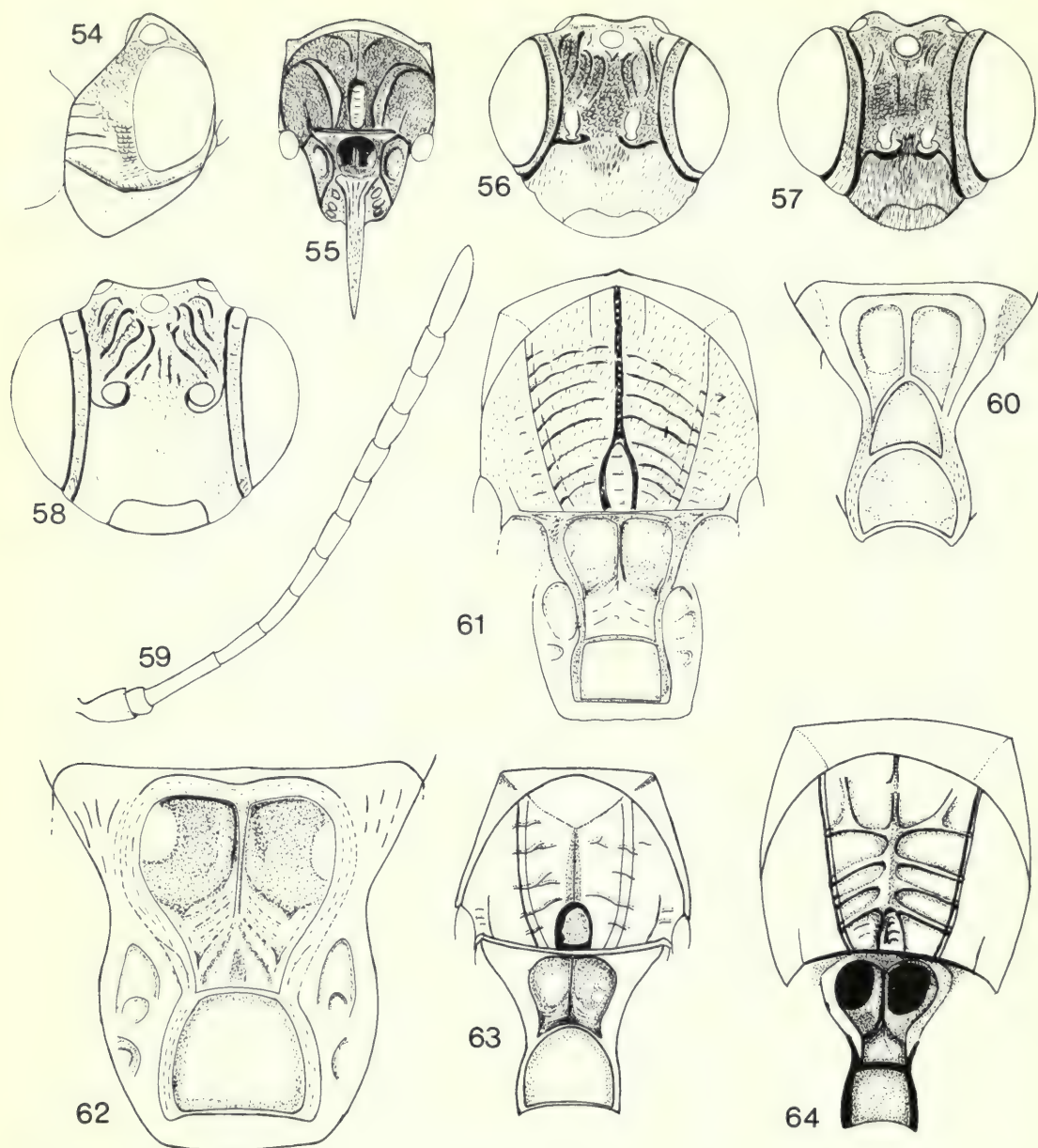
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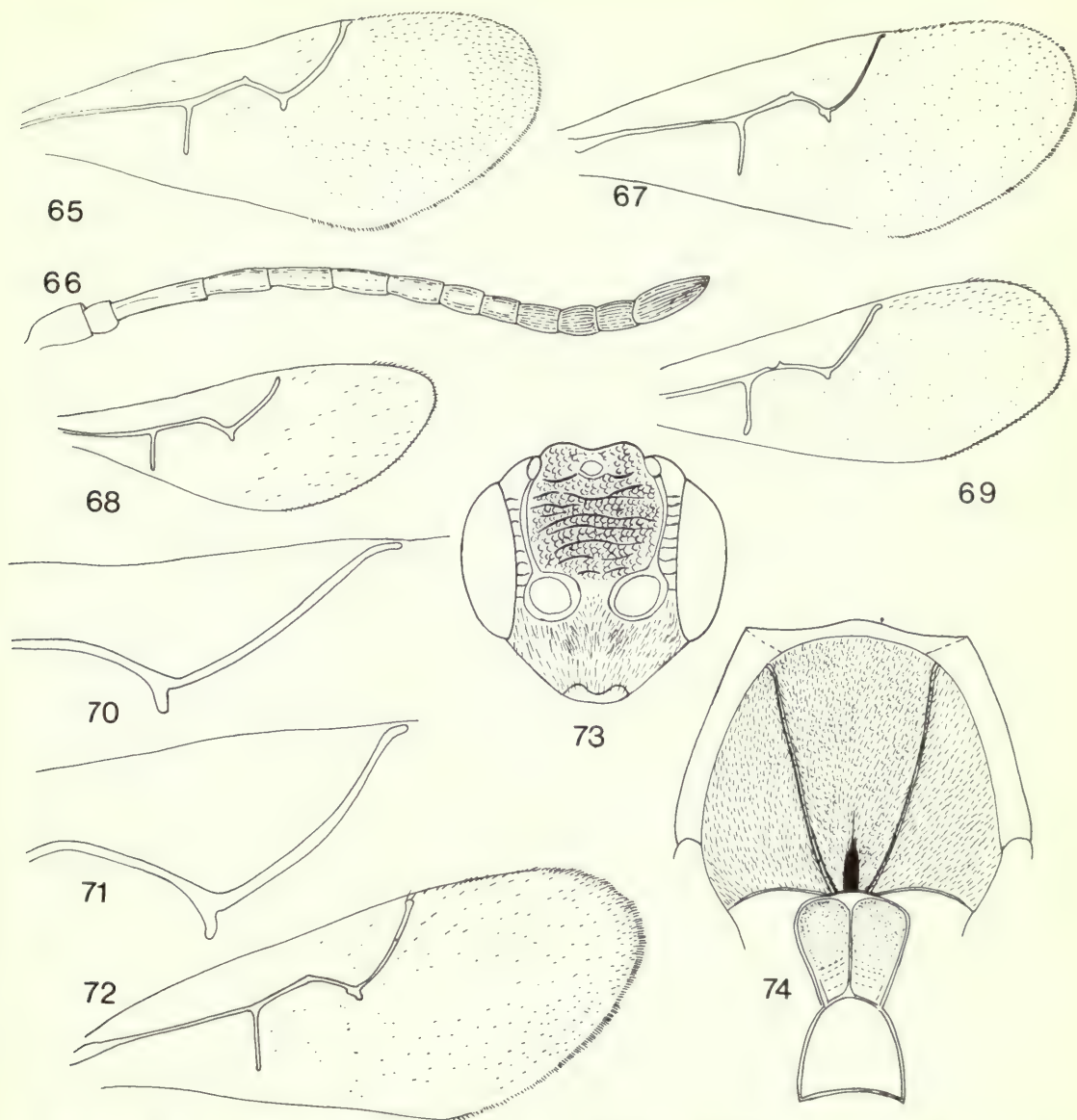
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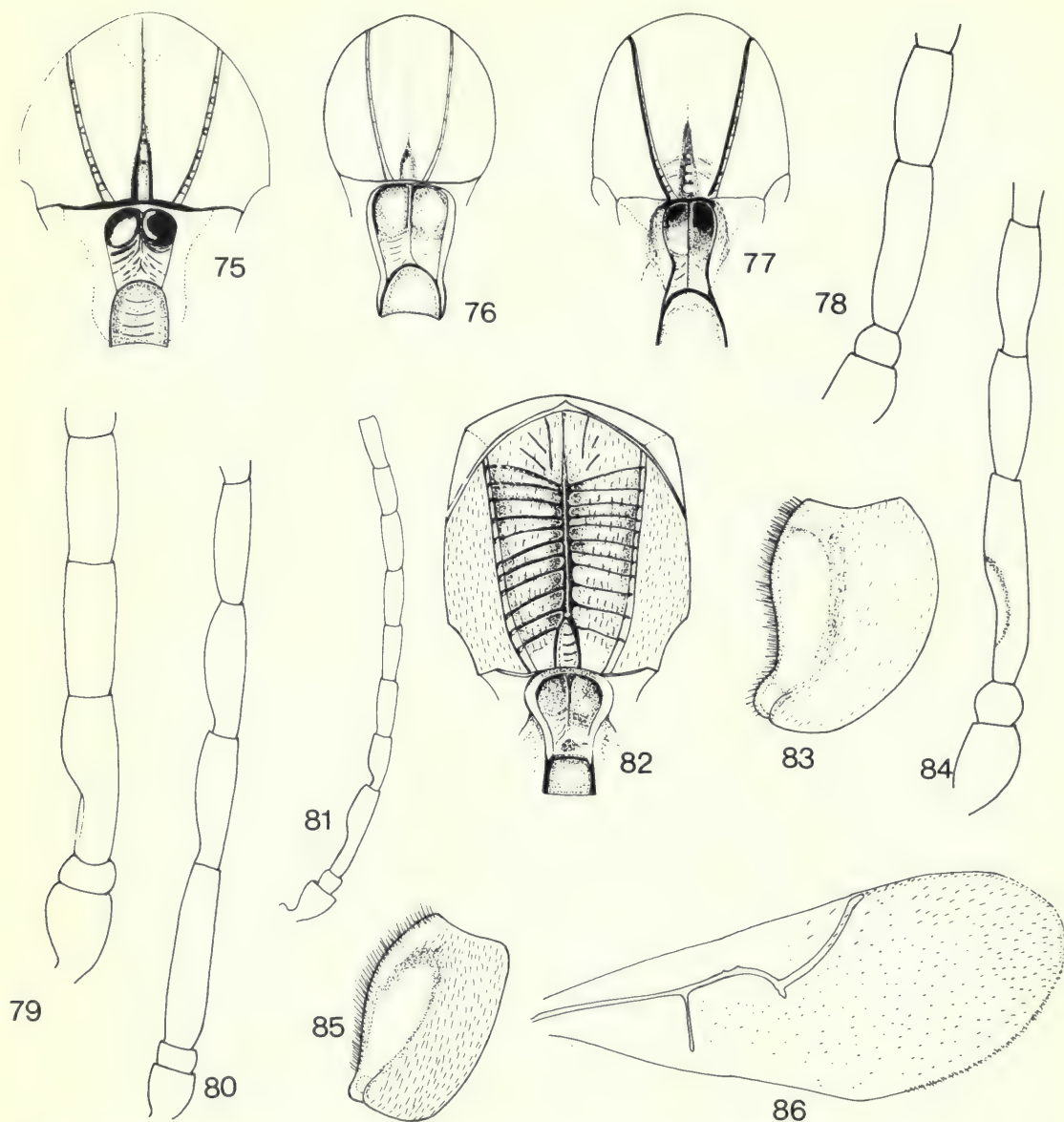
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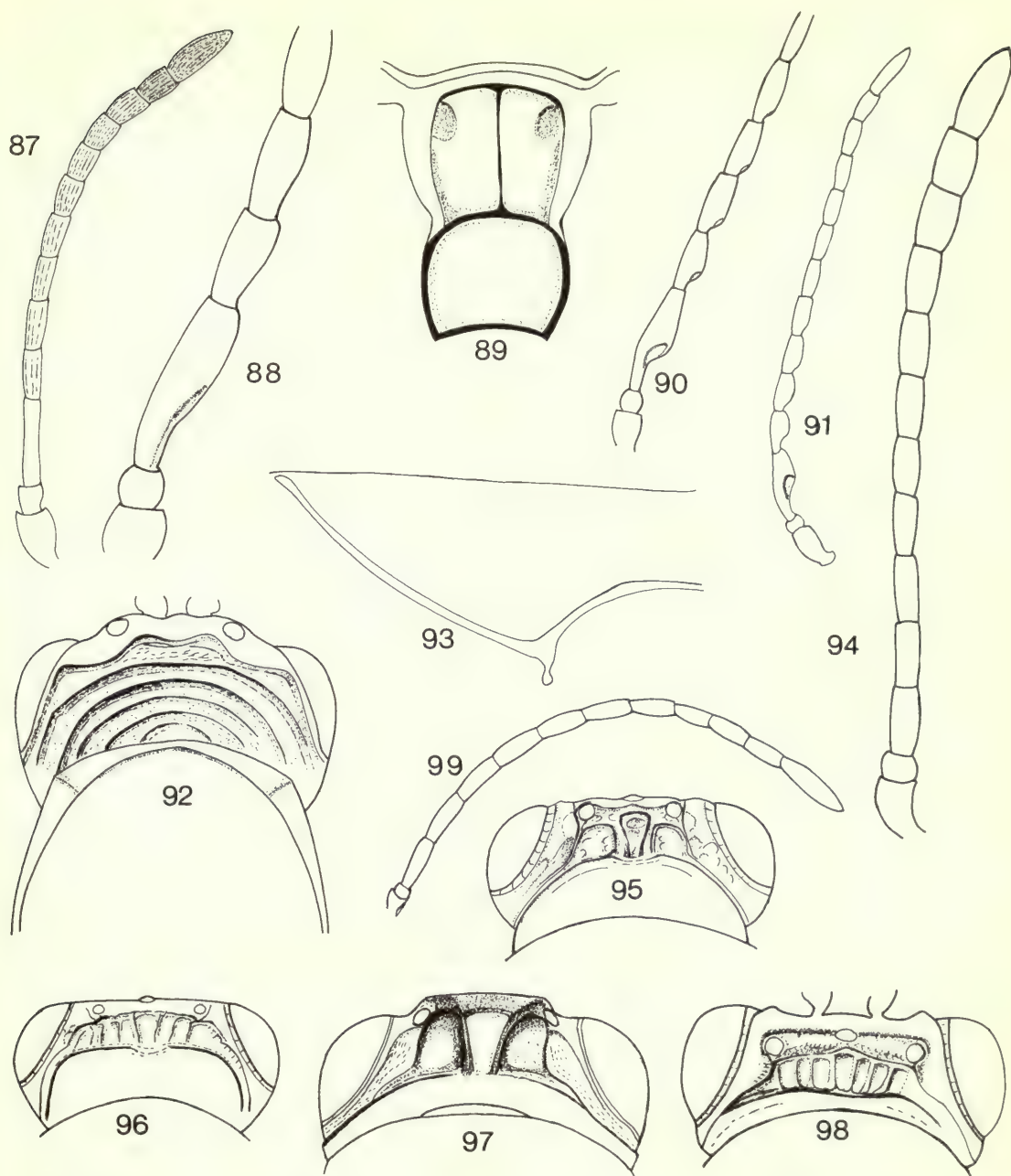
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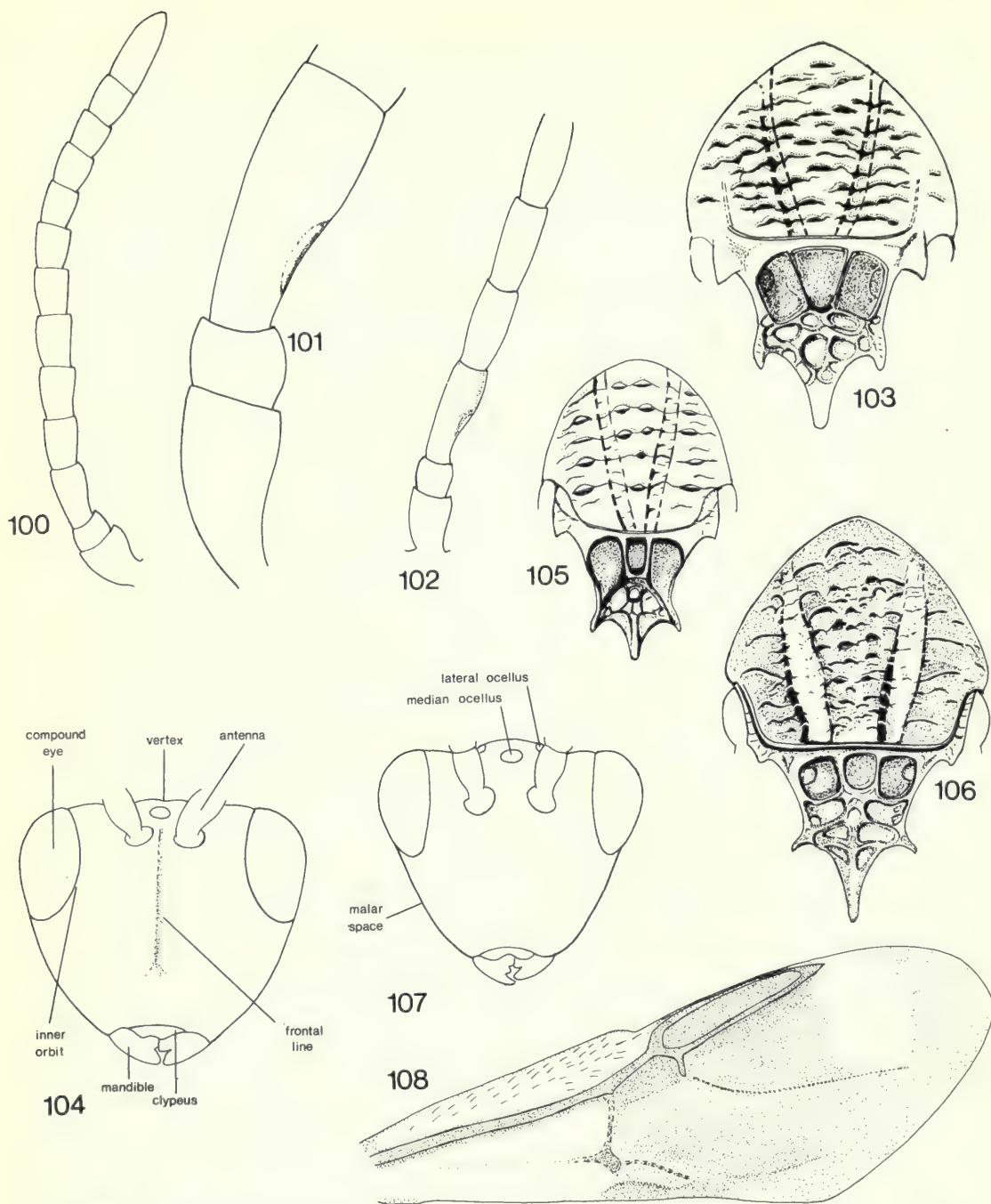
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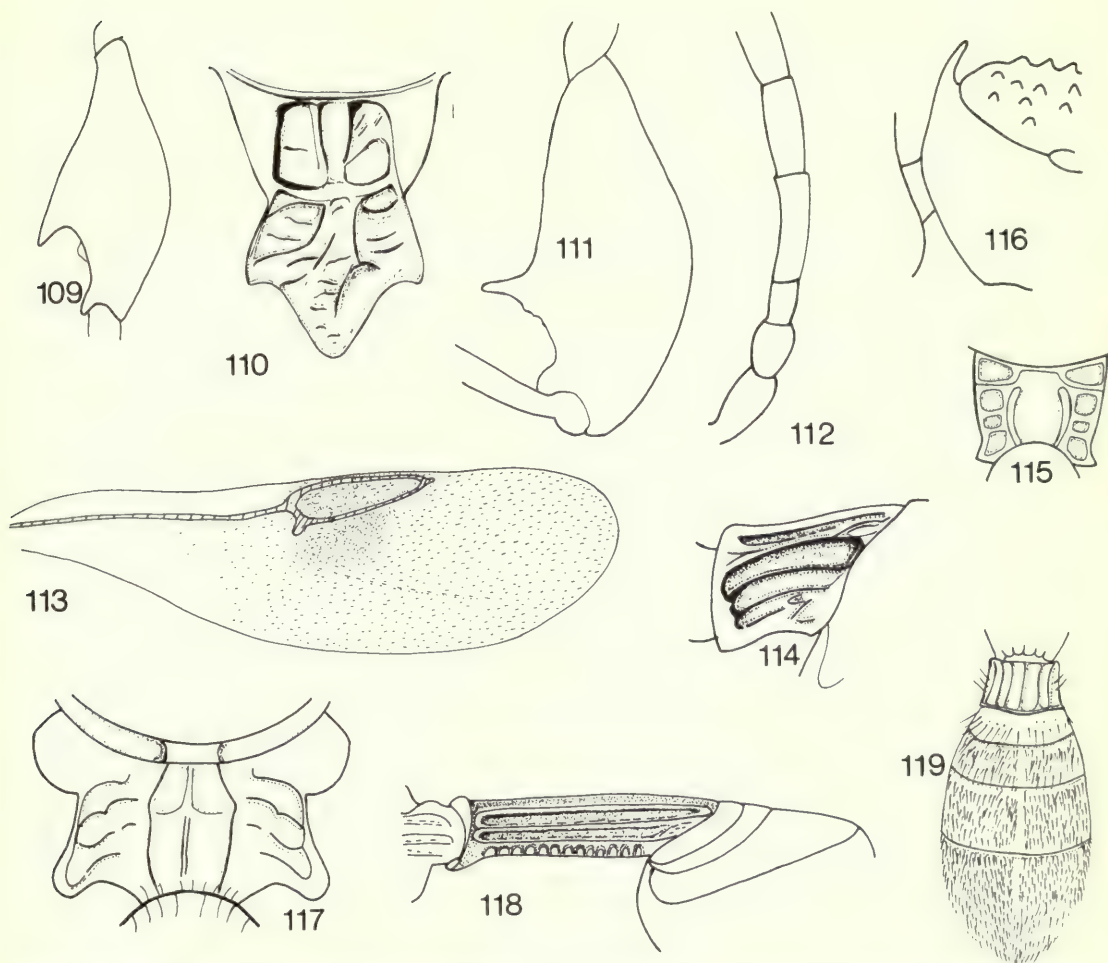
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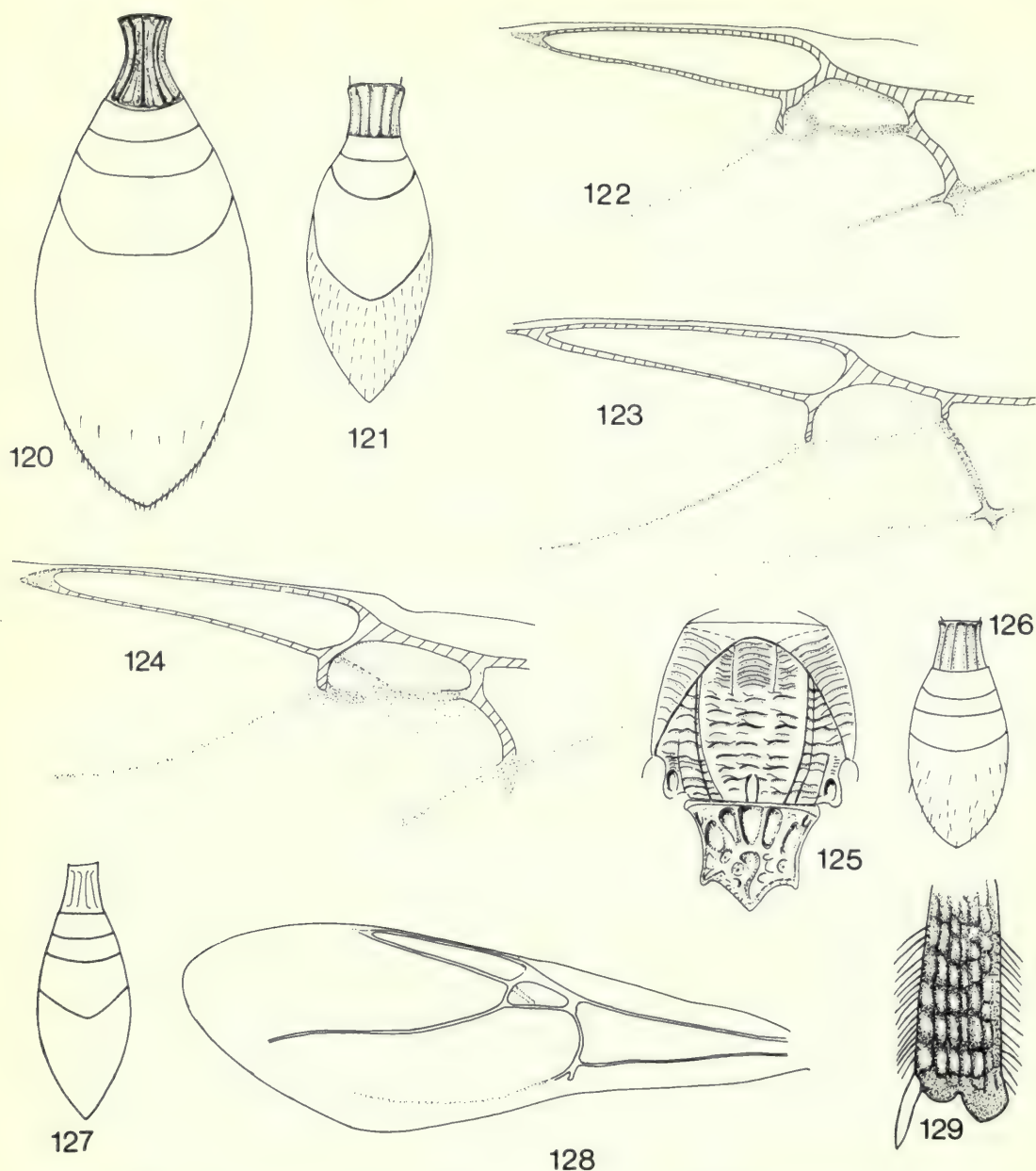
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A review of the genera of the Hydroptilida
(Trichoptera)

J. E. Marshall

Entomology series Vol 39 No 3 20 December 1979

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A review of the genera of the Hydroptilidae (Trichoptera)

J. E. Marshall^k

Department of Entomology, British Museum (Natural History), Cromwell Road, London SW7 5BD

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Synopsis

The Hydroptilidae, a world-wide group of small caddis flies, are reviewed down to the generic level for the first time. As previously, two subfamilies are recognized, the primitive Ptilocolepinae and the more typical Hydroptilinae, the latter being subdivided provisionally into six tribes, Stactobiini, Leucotrichiini, Ochrotrichiini (new), Neotrichiini, Hydroptilini and Orthotrichiini. Thirteen genera and two species are newly synonymized, three new combinations are established, one previously synonymized genus is reinstated and three genera (*Padunia* Martynov, *Tsukushitrichia* Kobayashi and *Petrotrichia* Ulmer) are transferred to other families of Trichoptera; thus 46 genera with 616 species are considered here as valid

members of the Hydroptilidae. For each genus accounts are given of the nomenclature, distribution, morphology of both adults and immature stages, biology and, where appropriate, species groupings. Keys are given to tribes for adults and to the world genera for both adults and larvae; keys are also provided to differentiate the Ptilocolepinae from the closely related families Rhyacophilidae and Glossosomatidae. The phylogeny of the family is briefly discussed and a synonymic checklist is given of all the species.

Introduction

As a result of a recent investigation into the morphology and biology of the Hydroptilidae, it became apparent that very little was known of the basic systematics of the family. Previous studies on the group have been very fragmentary and have consisted mainly of faunal descriptions and keys, there being no comprehensive appreciation of the family as a whole. The aim of this review has therefore been to investigate the higher classification of the Hydroptilidae with respect to the present knowledge of adult and larval morphology, biology and distribution. Provisional generic keys are given to the adults and to the known larvae, the latter incorporating morphological and case-form data. A full species checklist has also been included which, where possible, indicates tentative species groupings. However, a complete species review was beyond the scope of this work since the family contains over 600 species in 46 genera.

A number of interesting discoveries has been made regarding the systematics and taxonomy of the Hydroptilidae. Fourteen genera and one species have been synonymized for the first time, three species have been transferred to different genera and one genus has been reinstated; three genera have been transferred to other families of Trichoptera. Two subfamilies have been recognized, the primitive Ptilocolepinae and the more typical Hydroptilinae; within the latter six tribes have been provisionally proposed. The Stactobiini is a predominantly Palaearctic group with a small Nearctic component, the larval habits of which are paralleled by the exclusively New World Leucotrichiini. Two other small but distinct Nearctic tribes are the Ochrotrichiini and the Neotrichiini while the remaining assemblage of the generally more successful and more widely distributed genera has been tentatively split into the Hydroptilini and Orthotrichiini.

This revision has been based on the existing literature and on the examination of available adult and immature material. Each genus is separately discussed and data such as distribution, adult and larval diagnostic features, biological details and species groupings are given where possible. Before the detailed systematics are discussed, however, a brief historical review and introduction to the general morphology of the adult and immature stages are given.

Material

Most of the material examined is in the collections of the British Museum (Natural History) (BMNH); additional material was loaned or donated from the collections of the following individuals and institutions.

Higler, L. W. G.	Rijksinstituut voor Natuurbeheer, Leersum, Netherlands
Nybom, O.	Imatra, Finland
Ross, H. H.	Athens, Georgia, U.S.A.
Statzner, B.	Kiel, West Germany
MCM	Merseyside County Museums, Liverpool, England (Dr I. D. Wallace)
UHZIM	Universität Hamburg Zoologisches Institut und Zoologisches Museum, Hamburg, West Germany (Dr H. Weidner, G. Ulmer Collection)
USNM	Smithsonian Institution, National Museum of Natural History, Washington, D.C., U.S.A. (Dr O. S. Flint, Jr)
ZI	Zoological Institute, Leningrad, U.S.S.R. (Dr L. Zhiltzova, S. I. Lepneva Collection)

Historical review

'Trichoptera in general, but more especially the Hydroptilidae, are an annoyance to the Lepidopterist. If he lives near a river they are a constant source of disappointment to him whenever, on a summer evening, he inspects the entomological miscellany which accumulates upon his tablecloth beneath the gaslight. Down falls a crippled "Micro-"; he has the trouble of looking at it; but his

first glance detects the scabrous clothing of the anterior wings of a Micro-Trichopteron, whose hair looks as if it has been brushed the wrong way, in lieu of the scales of a Micro-Lepidopteron; and his only consolation is that he may leave the pinning of that kind of things to the Trichopterists.'

According to the attitude of most present day entomologists these words could well have been written just yesterday but they were, in fact, part of the introduction to the Reverend A. E. Eaton's paper 'On the Hydroptilidae, a family of the Trichoptera' written over 100 years ago in 1873. Since then the number of described genera and species has gradually increased from 6 and 21 to approximately 50 and 600 respectively but, as stated in the Introduction, little work has been done on the basic systematics of the group and much more material still needs to be collected. It is probably the small size of these insects which is the main deterrent to their collection and identification but, as in all groups, once they are purposefully sought they can be found in quite significant numbers.

The first review of the family was, as already mentioned, that of Eaton (1873) in which he erected four new genera and described six new species. Since then the number of described taxa has steadily increased due to the work of such notable trichopterists as McLachlan, Morton, Mosely and Kimmins in Britain; Ris, Klapálek, Martynov and Schmid on the Continent, and Ross and Flint in the U.S.A. Amongst these, Mosely is perhaps best known for his singular contribution to the description of many new hydroptilid taxa not only from Great Britain and Europe but also many then less well-known regions such as South America, Australia and New Zealand; indeed, according to Kimmins (1951), the family Hydroptilidae was Mosely's favourite group. Kimmins, continuing the work of his predecessor, Mosely, also described a number of new taxa but his most notable contribution was probably his revision of the British species of *Oxyethira* (Kimmins, 1958), a genus with rather complex male and female genitalia, despite which Kimmins succeeded in providing descriptions, figures and keys to both sexes of almost every British representative. Of the Continental contributors, Schmid is perhaps best known for his descriptions of many new exotic genera and species from Sri Lanka, Iran and Pakistan (Schmid, 1958*a*; 1959*b*; 1960) and for his review of the genus *Stactobia* (Schmid, 1959*a*).

Ross, as well as describing many new Nearctic taxa, was the first to break away from the almost classical use of wing venation in the taxonomy of the Hydroptilidae which, due to the small size of these insects, does not provide such reliable characters as it does in the groups of larger caddis flies. Instead Ross employed basic structures of the head, thorax and abdomen which provide more stable features for the differentiation of genera and are also indicative of possible phylogenetic relationships within the Hydroptilidae and between trichopterous families in general. The features thus used by Ross have provided the foundation for the studies outlined in this review. Finally, Flint has made impressive contributions to our knowledge of the Central and South American hydroptilid fauna, especially in his reviews of the Leucotrichiini and the genus *Ochrotrichia* (Flint, 1970; 1972*a*) and his studies on certain faunal regions such as Jamaica and Surinam (Flint, 1968*b*; 1974).

The larvae, on the other hand, are less well documented as regards specific descriptions although a significant amount is known at the generic level due to the work of a number of authors of whom special mention should be made of Nielsen. In his monumental work on 'The biology of the Hydroptilidae', Nielsen (1948) describes the morphology, life histories, feeding and case building behaviour of five hydroptilid genera with such detail and accuracy that no subsequent work on this subject has surpassed or even equalled it. Unfortunately it does tend to give rather a restricted impression of hydroptilid larvae in general because it concerns only five of the relatively more advanced and specialized genera and does not stress the diversity of the group as a whole. Nevertheless, it is hoped that this present review will give a much broader appreciation of the family, not only in its immature but also its adult stages, because this cosmopolitan group probably has the greatest ecological, morphological and behavioural diversity within the whole of the order Trichoptera.

Subfamily classification

Stephens (1836) erected the family Hydroptilidae for the genera *Hydroptila* Dalman, *Agraylea*

Curtis and *Narycia* Stephens of which, however, the only species figured, *Narycia elegans* Stephens, subsequently proved to be a tineid moth of the family Psychidae. The Hydroptilidae were basically distinguished from other families of Trichoptera by the unfolded posterior wings and the filiform antennae of the adults and the 'cleft-like' openings of the larval cases. The cases and larvae of *Hydroptila pulchricornis* Pictet and *Oxyethira flavicornis* (Pictet) (as *Hydroptila*) had first been described and illustrated by Pictet (1834) and, in fact, McLachlan (1880) considered Pictet to be the true founder of the family since he had been the first to consider the group as a distinct taxon under the general name of 'les Hydroptiles'.

Nielsen (1948) was the first to attempt to divide the then large and heterogeneous group of hydroptilid genera into subfamilies. Thus Nielsen proposed the Orthotrichiinae for *Orthotrichia* and *Ithytrichia* and the Hydroptilinae for *Agraylea*, *Oxyethira* and *Hydroptila* on the basis of the morphological affinities of the larvae. However, although Nielsen was aware of the other genera known at that time, he only remarked on the relative positions of *Ptilocolepus* and *Stactobia* in his scheme. The subfamily Stactobiinae was erected by Botosaneanu (1956) for *Stactobia* and 'its immediate relatives' which, although not expressly named at the time, probably included *Stactobiella*, *Plethus*, *Plethotrichia*, *Lamonganotrichia* and, possibly, *Catoxyethira*. Ross (1956) proposed a new classification of the Hydroptilidae to include the Ptilocolepinae, a small subfamily consisting of just two small genera with glossosomatid-like adults but typically hydroptilid-like larvae. Ross thus divided the Hydroptilidae into the Ptilocolepinae and the Hydroptilinae, the latter being further subdivided into the Hydroptilini and the Neotrichiini. Flint (1970) subsequently did not adopt Ross's (1956) classification when he proposed the subfamily Leucotrichiinae (later emended to Leucotrichiinae by Flint, *in litt.*) for the Neotropical genus *Leucotrichia* and its related genera, since he retained the Ptilocolepinae, Stactobiinae and Orthotrichiinae as distinct subfamilies. Once again, however, the Hydroptilinae was left as a large and very heterogeneous group; Table 1 shows the two principal approaches to the subfamily classification of the family and compares them with the system to be adopted here. The present views are based on those of Ross (1956) in that only two subfamilies are recognized, with the Hydroptilinae being split into six tribes which correspond to the subfamilies proposed by Flint (1970). These tribes, however, appear to exhibit a number of common features which unite them and distinguish them as a whole from the Ptilocolepinae.

Table 1 Summary of the three views of the subfamily classification of the Hydroptilidae

Nielsen (1948) Botosaneanu (1956) Flint (1970)	Ross (1956)	Proposed classification
PTILOCOLEPINAЕ	PTILOCOLEPINAЕ	PTILOCOLEPINAЕ
STACTOBIINAЕ	HYDROPTILINAЕ	HYDROPTILINAЕ
LEUCOTRICHIIINAЕ	HYDROPTILINI	STACTOBIINI
ORTHOTRICHIIINAЕ		LEUCOTRICHIIINI
HYDROPTILINAЕ		ORTHOTRICHIIINI
		OCHROTRICHIIINI
		HYDROPTILINI
	NEOTRICHIIINI	NEOTRICHIIINI

Systematic position within the Trichoptera

Eaton (1873) first recognized the relationships between adult hydroptilids and rhyacophilids after agreeing with Pictet's (1834) observations that the maxillary palpi of both sexes of the former are five-segmented, thus placing the family in the old subdivision Aequipalpidae (later known as the Aequipalpia). McLachlan retained the Hydroptilidae in the Aequipalpia but, on the basis of the case building habits of the larvae, placed the family between the 'tube-case' building families Sericostomatidae and Leptoceridae. McLachlan also regarded *Ptilocolepus* as a member of the Glossosomatinae ('section II of the Rhyacophilidae') but noted that 'the affinities are certainly

with *Agapetus*' (Glossosomatinae) 'but the thickened erect hairs of the anterior wings show an analogy in the direction of the Hydroptilidae'.

Mosely (1939), on the basis of adult features, considered the family to be closely related to the Rhyacophilidae and had particular difficulty in assigning the Nearctic *Protoptila* group to either one of these families, at first including it in the Hydroptilidae but later transferring it to the Glossosomatinae–Rhyacophilidae (Mosely, 1954) (see discussion on *Padunia*).

Nielsen (1948), using larval and pupal characters, placed the Hydroptilidae between the 'saddle-case' building Glossosomatinae and the 'tube-case' making Integripalpia, the affinities with the latter being particularly evident in the form of the larval antennae and prolegs. Nielsen concluded that the subfamily Hydroptilinae sensu Nielsen (see Table 1) was closest to the Integripalpia, while the Orthotrichiinae sensu Nielsen retained the primitive features of the Rhyacophilidae. Nielsen's views were, however, based entirely on the external morphological features of the larvae which, it should be noted, may be subject to functional modifications correlated with the case building habit. His conclusions regarding the affinities of the Hydroptilinae and the Integripalpia may thus have been influenced by the occurrence of superficially similar characters which have resulted from parallel evolution within the two groups.

Milne & Milne (1939), on the basis of larval anatomy, behaviour and case-form, concluded this of the family: 'the Hydroptilidae is probably more closely related to the Glossosomatinae than the Glossosomatinae to the Rhyacophilidae . . . Hydroptilid larvae being more specialized in the direction of the differentiation of the ends of the case (feeding from one particular end, etc.) than Glossosomatiniids.'

The first serious attempt to construct a phylogenetic classification of the order Trichoptera was made by Ross (1956) who based his conclusions on a comparative study of adult and immature morphology and larval case making behaviour patterns. From this study Ross deduced a set of primitive adult and larval characters and followed the development of these within each group, his findings regarding the evolution of the order being summarized in Chart 1; in this chart the relationships of the Hydroptilidae have been emphasized.

According to Ross (1956), the ancestral caddis fly gave rise to two major evolutionary lines: the 'fixed retreat division', where the larvae simply spin silken nets in which they live and trap their food (the Philopotamidae and the Hydropsychidae–Psychomyiidae complex), and the 'case-maker division', containing all of the remaining families. Within the latter group the most primitive representatives are considered to be the free-living Rhyacophilidae which build stone-covered silken pupal shelters. The early ancestors of the Rhyacophilidae gave rise to the primitive glossosomatid-line, in which the larvae build transportable cases and which in turn gave rise to the more advanced 'saddle-case' building Glossosomatidae and the 'purse-case' building Hydroptilidae. The final step in the evolution of the case building habit was the adoption of the 'tube-case' form as seen in the higher limnephiloid families. Ross considers this major branch to have arisen from the same ancestor as that which gave rise to the hydroptilid line and not from the 'tube-case' building hydroptiline tribe, the Neotrichiini, which would appear to have evolved directly from an early ancestor of the Hydroptilinae. The Ptilocolepinae are considered to be an early offshoot of the hydroptilid line in which many adult features of the more primitive Glossosomatidae have been retained.

In conclusion it would thus seem that the Hydroptilidae may be regarded as a specialized but early offshoot of the case-making branch of the Trichoptera. The family is included in the Rhyacophiloidea, along with the Rhyacophilidae and Glossosomatidae, the other main subdivision being the Limnephiloidea which contains the Limnephilidae, Sericostomatidae and the Leptoceridae. The Hydroptilidae share a common ancestry with the Glossosomatidae with which they have both larval and adult affinities, the latter being most marked in the Ptilocolepinae which also exhibit pupal features intermediate between the Glossosomatidae and the Hydroptilinae. The Hydroptilidae is also regarded as being an early offshoot of the line leading to the Limnephiloidea.

General morphology

Adult

There is a marked difference between the general appearance of the two hydroptilid subfamilies.

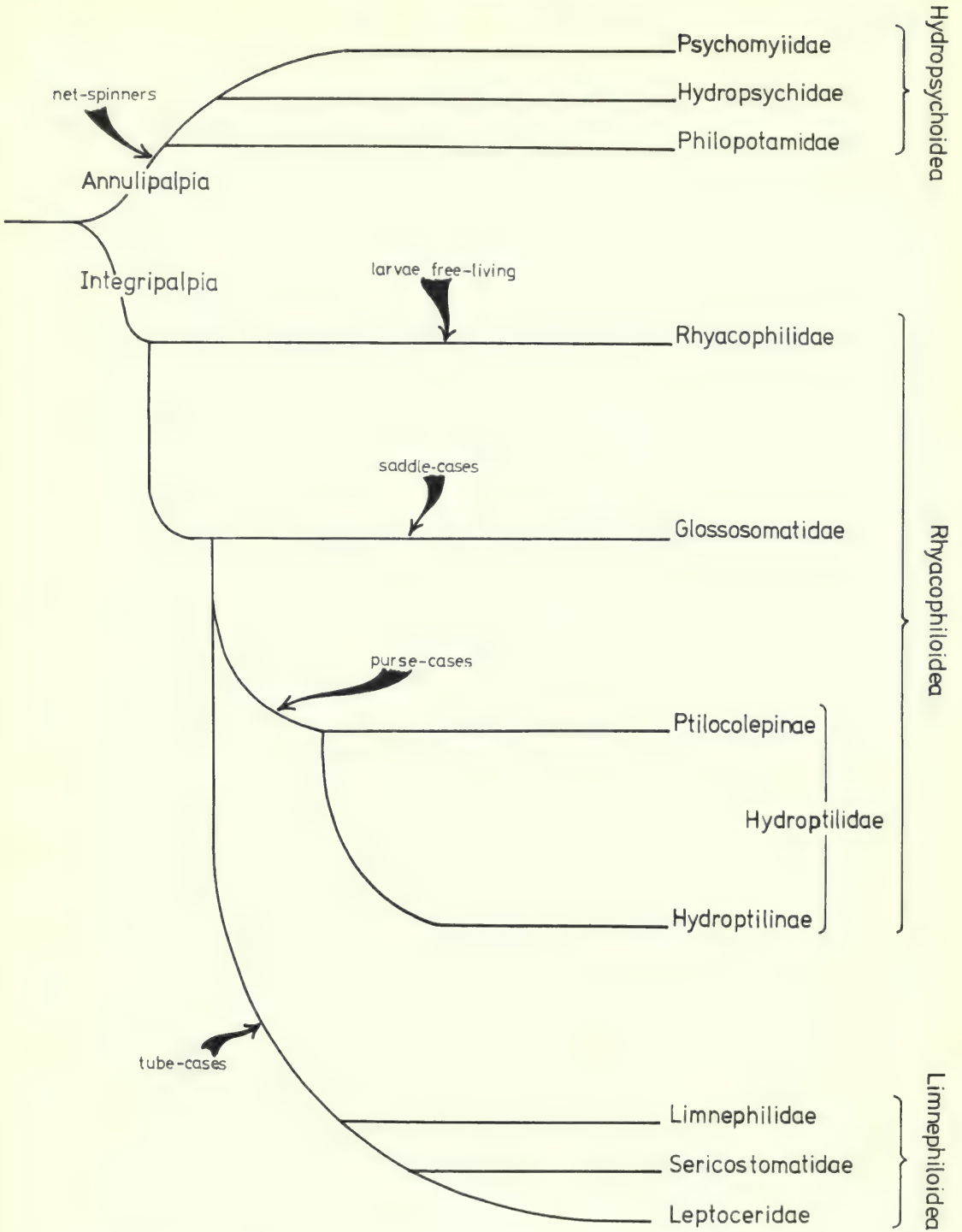


Chart I The position of the Hydroptilidae within the order Trichoptera (after Ross, 1967).



Fig. 1 *Hydroptila tineoides* Dalman, ♂.

The Hydroptilinae have what is normally regarded as the typical hydroptilid form, being small with narrow, pointed wings, long costal fringes, reduced venation and an overall pubescent appearance due to the wings and parts of the body being densely covered in setae (Fig. 1). The Ptilocolepinae, however, look more like small rhyacophilids and glossosomatids, the wings being relatively broad with rounded apices, short costal fringes, an almost full complement of veins (Fig. 5) and a granulose, rather than pubescent appearance due to the presence of sparsely scattered short, unmodified macrotrichia more typical of the order Trichoptera.

The Ptilocolepinae tend to have a rather uniform dark brown to black appearance, reflecting the basic colour of the body, whereas the coloration and markings of the Hydroptilinae are dependent on the arrangement of the setae. These have the same effect, to a certain extent, as the overlapping scales of Lepidoptera and hydroptilids are often mistaken for small moths at first sight, as first noted by Eaton (1873). Hydroptilid setae are usually black, or brown, and white and give the insects a mottled or 'salt and pepper' appearance although, in *Agraylea* for example, this may be partly due to spotting of the wing membrane itself. Distinct metallic hues are seen in some tropical genera and are often caused by the presence of localized groups of modified, scale-like setae.

The Hydroptilidae are described as being small to minute insects and are often termed the 'micro-caddis'. The average forewing length (middle of prothorax to apex of wing) of the Ptilocolepinae is 5 mm (4–6 mm), while that of the Hydroptilinae is 3.5 mm (1.2–6.0 mm). A full account of adult hydroptilids will not be given here; however, those features of taxonomic importance referred to in the systematic section will briefly be described below.

Head capsule

The number of dorsal ocelli varies from the basic complement of 3, to 2 and 0. Posteriorly there is usually a pair of dorsal postoccipital lobes or warts which are somewhat variable in shape, and in the males of the genus *Hydroptila* these are modified as hinged caps which conceal eversible scent dispersing organs lodged in the rear of the head cavity (Fig. 114).

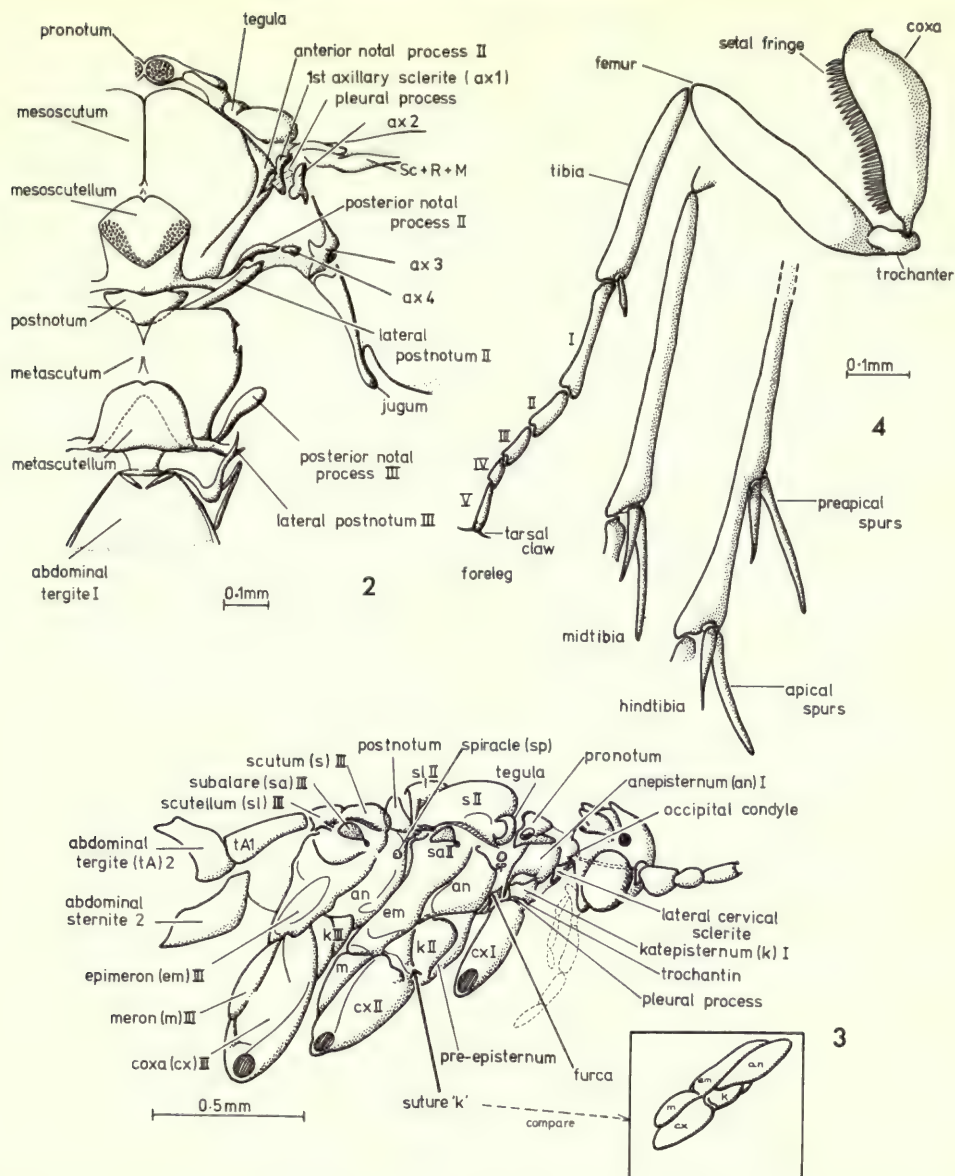
Thorax

The small, ring-like prothorax bears a pair of setigerous protuberances or 'warts' which, in the Hydroptilidae, are characteristically set close together (Figs 53, 62, 83, 108, 114, etc.). The shape of the meso- and metathoracic nota and the presence or absence of transverse sutures provide excellent diagnostic characters at both the subfamily and generic levels; Fig. 2 shows the general terminology employed here. The posterior mesothoracic katepisternal suture (Fig. 3, suture 'k') is characteristically present in the Ptilocolepinae. Ross (1956) first noted the 'general absence' of this suture in the Hydroptilinae (Fig. 3, inset), but I have found this to be a consistent feature of the subfamily. An important feature of hydroptilid taxonomy is the spur formula which refers to the number of tibial spines commonly present on each leg. The maximum number on any one leg is four, consisting of two preapical and two apical spurs; the spur formula gives the number of spines on the fore-, mid- and hindlegs respectively and, for example, in *Stactobia* (Fig. 4) is given as 1.2.4.

The general form of the wings has already been described, the more primitive condition being seen in the Ptilocolepinae (Fig. 5). Here the venation is well developed and resembles that of primitive rhyacophilids (*vide* Ross, 1956 : figs 154, 155) from which it differs in the subcosta (*Sc*) of the forewing and, from rhyacophilids in general, in the fusion of various veins in the hindwing. The Ptilocolepinae differ from the Hydroptilinae in possessing a distinct discoidal cell (*dc*), separate M_3 and M_4 and a forked Cu_1 in the forewing (Fig. 5). The Hydroptilinae are noted for their narrow pubescent wings, reduced venation and long costal fringes (Figs 1, 6–10). In the larger genera, such as *Ugandatrichia* and *Agraylea* (Figs 6, 7), the wings are slightly broader and less pointed apically, the costal fringes are short, the raised setae less dense and the neuration more regular. However, the wings of most hydroptilines are long, slender and highly acuminate. As the overall size of the insect decreases so the wings become reduced and the venation less distinct while the costal fringes become longer to compensate for the loss in wing membrane area. The most extreme examples of wing reduction are seen in *Chrysotrichia* and *Neotrichia* (Fig. 8) (average forewing length 1.5 mm) where the wings are reduced to thin, ribbon-like strips and the venation reduced essentially to the main longitudinal branches *R*, *M* and *Cu*. The compensatory development of the costal fringes parallels the condition seen in other insect groups such as the Thysanoptera, the Trichogrammatidae and Myrmaridae (Hymenoptera) and the Ptiliidae, Clambidae, Corylophidae and some Staphylinidae (Coleoptera). Venational features of the Hydroptilinae do not provide reliable taxonomic characters because, at such reduced dimensions, small variations in crossveins and forks, for example (all of taxonomic importance in the families of larger Trichoptera), are not constant in genera and species of the Hydroptilinae.

Abdomen

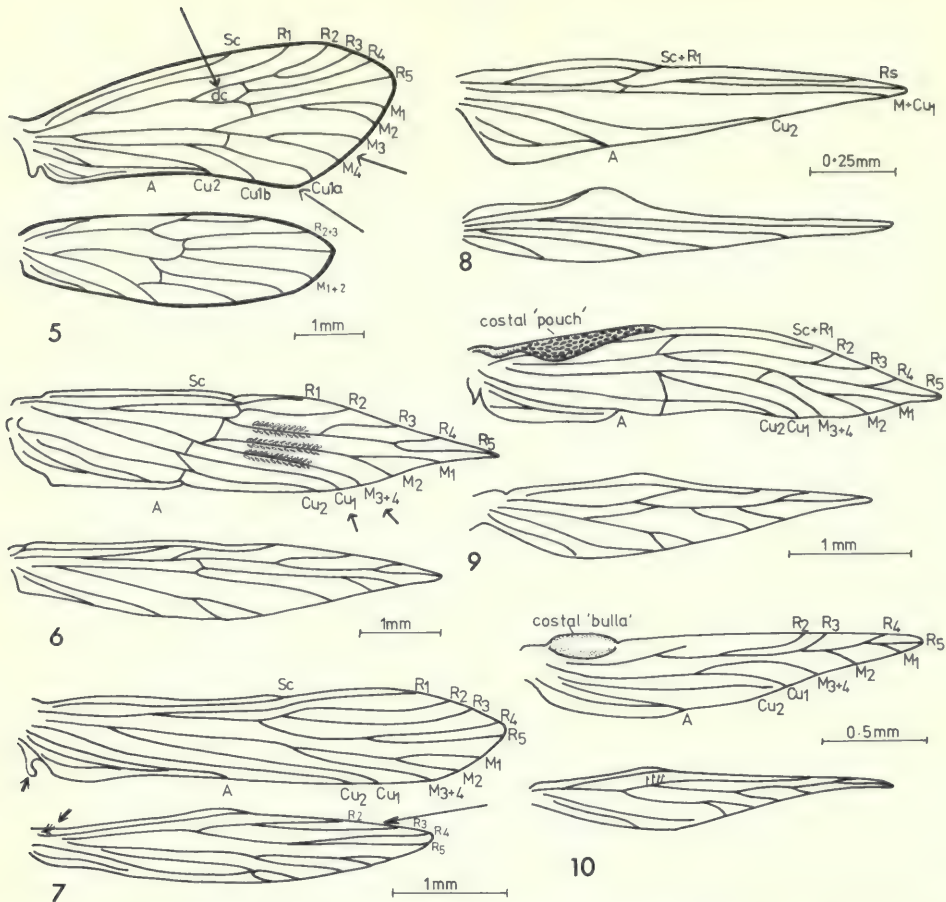
This consists of the usual eleven basic segments (X and XI being regarded as one) and the sclerites of the posterior segments are modified to form the genitalia. In all hydroptilid genera examined there is a pair of small sternal glands of unknown function which open anterolaterally on the fifth abdominal sternite in both sexes. The external structures associated with these glands differ markedly between the two subfamilies. The Ptilocolepinae again resemble the Rhyacophilidae and Glossosomatidae in having a well-developed sternal ridge (Fig. 11) which, in *Ptilocolepus*,



Figs 2-4 Adult thorax and legs. 2, *Agrylea* sp., thorax and wing base, dorsal view (ax, axillary sclerite); 3, Ptilocolepine, thorax, lateral view (inset, Hydroptilinae, mesopleuro-coxal sclerites); 4, *Stactobia mclachlani* Kimmins, legs and spur formula (1.2.4).

has a pair of long, slender, membranous filaments arising from its anterolateral corners. In the Hydroptilinae there is simply a pair of shallow, subcircular pits in the anterolateral corner of the fifth sternite, from which there also arises a pair of short, posteriorly directed, setate, finger-like processes (Figs 12, 14). *Tricholeiochiton fagesii* (Guinard) is so far unique within the subfamily since there is no process and the surface of the relatively broader pit is irregularly sculptured (Fig. 13). *Ithytrichia lamellaris* (Eaton) (Fig. 14) appears to exhibit an intermediate condition with its reduced process (but relatively elongate seta) and faintly sculptured pit.

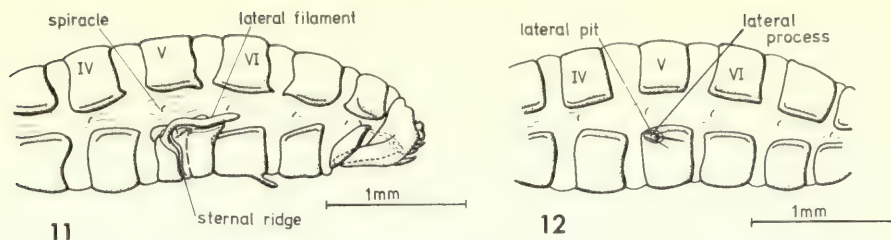
The external genitalia of the Hydroptilidae provide very useful diagnostic characters at both the generic and specific levels. Most species are described from the males only but it has been



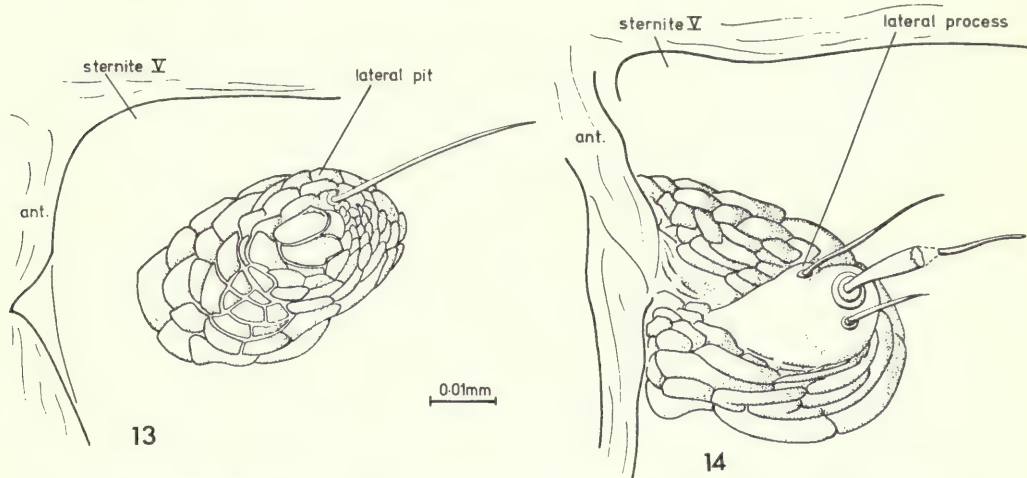
Figs 5–10 Wing venation. 5, *Ptilocolepinae*, *Ptilocolepus granulatus* (Pictet). 6–10, *Hydroptilinae*, (6) *Ugandatrachia cyanotrichia* (Kimmins); (7) *Agraylea* sp.; (8) *Neotrichia anahua* (Mosely); (9) *Abtrichia antennata* Mosely, ♂; (10) *Costatrachia lodora* Mosely, ♂.

found that, if carefully prepared and studied, the female genitalia can also provide useful taxonomic and phylogenetic features. Very little is known of the comparative morphology of hydroptilid genitalia and, as may be expected, authors vary considerably in their terminology of the various structures involved. As a detailed account of hydroptilid genitalia morphology and nomenclature cannot be given here, reference should be made to the generalized diagrams of male and female hydroptilid genitalia (Figs 15–17) which show the terminology to be adopted in this account. However, a short description of the basic features will be given below and a more detailed study of the male genitalia of *Hydroptila occulta* (Eaton), *Agraylea multipunctata* Curtis and *Orthotrichia costalis* (Curtis) is given by Nielsen (1970).

Male. Segment IX forms a distinct genital capsule with a membranous posterior depression (genital chamber) from which arise segment X (the dorsal plate) and the ventral inferior appendages, the aedeagus lying between these two structures. Internal apodemes may arise from the lateral anterior margins (as in the Stactobiini, Figs 65–68) and various external processes may project posteriorly from the anal margin (e.g. *Hydroptila*, Figs 115–117 and *Orthotrichia*, Fig. 135); the latter are termed the side pieces or the lateral or intermediate processes. Segment X is represented by the tergite only and projects from the dorsal posterior margin of segment IX; it is usually entirely membranous, or sometimes weakly sclerotized, and its size and shape vary considerably between taxa. The ventral face of tergite X may fuse with structures ventral to the aedeagus to form a distinct phallic tube, or phallocrypt.



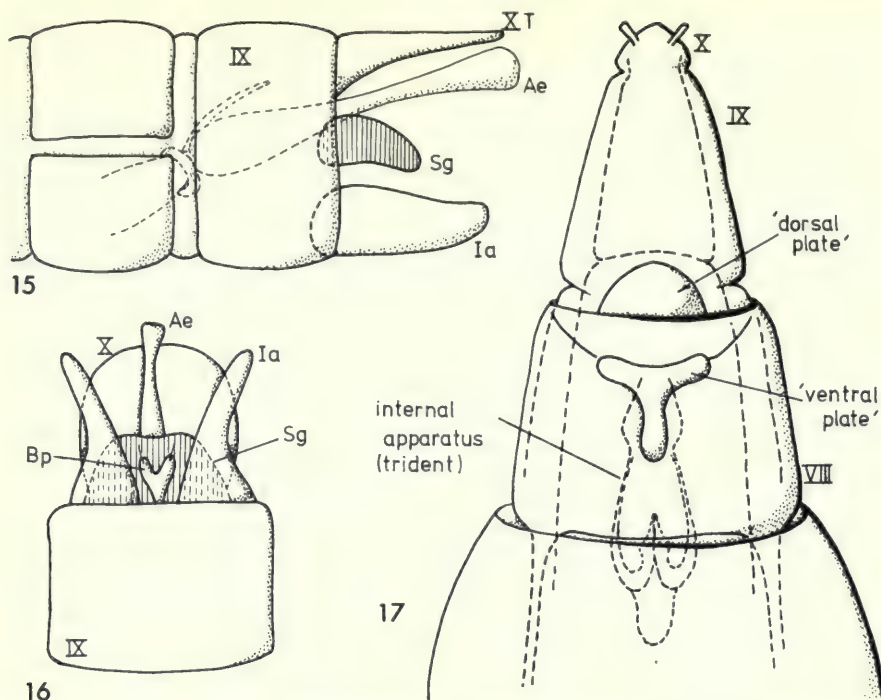
Figs 11-12 Abdomen and sternal gland, lateral view. 11, *Ptilocolepinae* (*Ptilocolepus granulatus* (Pictet)); 12, Hydroptilinae, generalized.



Figs 13-14 Sternal gland, abdominal sternite V, antero-dorsal corner, lateral view. 13, *Tricholeiochiton fagesii* (Guinard); 14, *Ithytrichia lamellaris* Eaton.

There has been much confusion over the use of the terms 'superior', 'intermediate' and 'inferior' appendages. True superior appendages, as found in the majority of Trichoptera, are considered by Nielsen (1970) to be absent in the Hydroptilidae; when used in context with this family the term usually refers to a secondarily developed structure. The term 'intermediate' has been variously applied to what has also been referred to as 'superior' and also to what are here called the 'subgenital appendages'. The latter is a non-committal term used to refer to any structure ventral to the aedeagus; when paired they are called appendages (= 'lateral penis-sheaths', 'parameres', 'intermediate appendages') and when fused the structure is termed the 'subgenital plate' (= 'lower penis cover', 'ventral plate of X').

The inferior appendages (gonopods), or 'claspers' as they are usually termed, are one-segmented in the Hydroptilidae as opposed to the two-segmented condition normally found in Trichoptera. They vary considerably in shape, size, additional processes and setae, and provide very useful diagnostic characters at both generic and specific levels (see Figs 55-57, 65-68, 84, 94, 101, 109, 115-117, 122, 129, 131, 135, 140). Ross (1948) introduced the term 'bracteole' for the structure arising from the base of the clasper (Fig. 101), while 'bilobed process' is introduced here to refer to the delicate membranous processes which are seen in a number of genera of the Neotrichiini, Hydroptilini and Orthotrichiini (e.g. Figs 16, 122, 129, 135, *Bp*). The bilobed process usually lies just ventral to the subgenital plate and, although its form is somewhat variable, it consists basically of a pair of short, posteriorly directed processes, each with an apical seta. In *Orthotrichia* (Fig. 135, *Bp*) they may be represented by the single median process formed by the fusion of the paired organs, while in *Oxyethira* (Fig. 122, *Bp*) two pairs of processes would appear to be present which apparently arise from the base of the subgenital plate. It is obvious that much more research into the homologies of hydroptilid genitalia is required.



Figs 15–17 Hydroptilid genitalia, generalized. 15, ♂, lateral view; 16, ♂, ventral view; 17, ♀, ventral view. (*Ae*, aedeagus; *Bp*, bilobed process; *Ia*, inferior appendage; *Sg*, subgenital process.)

The copulatory organ ('penis', 'phallus') will simply be referred to here as the aedeagus (Figs 15, 16, *Ae*) as I have made no attempt to homologize the various structures that occur in the Hydroptilidae. The aedeagus is thus basically a long, slender sclerotized tube which, in the Neotrichiini, Hydroptilini and Orthotrichiini (Figs 101, 109, 122, 135, 140, *Ae*) is distinctly divided into two regions, the proximal, muscular-walled ejaculatory duct and the slender, distal intromittent organ, and also bears a single, spiral 'titillator'. In the other hydroptilid groups where the aedeagus is apparently undivided, the homologies are unknown; each group would appear to have its own specialized structure. In the Stactobiini there is basically a common median duct with a pair of lateral processes which may be variously fused (Figs 69–73). The Leucotrichiini have a very complex structure with 'basal loops' and 'windows' and a membranous apex (Fig. 84) while the Ochrotrichiini have an aedeagus which may be very slender (Fig. 94) or heavily spined (Fig. 96). Again, research into the homologies of the hydroptilid aedeagus could prove very rewarding both taxonomically and phylogenetically.

Female. In the Hydroptilidae the female genitalia (Fig. 17) are of the generalized trichopteran condition which is of the simple 'telescopic ovipositor' or 'oviscapt' form (Scudder, 1971). This essentially involves modifications of segments VIII–X and the gonopore is situated ventrally between segments IX and X or, when the sternite IX is reduced as in *Oxyethira* (Fig. 121), apparently just behind segment VIII.

The posterior margin of the ring-like segment VIII bears a number of useful characters such as rows of setae and dorsal and ventral processes and excisions (see Marshall, 1978 for figures of the female genitalia of the British Hydroptilidae). The anterior margin may bear a pair of slender lateral apodemes (Figs 17, 82, 121, 134) and the sternite may have patches of modified setae or, as in *Hydroptila occulta* (Eaton) (Marshall, 1977; 1978), a characteristically shaped sclerite termed the 'ventral plate' by Nielsen (1970) (Fig. 17). The long, slender segment IX forms a retractile 'oviscapt' (Scudder, 1971) or 'false ovipositor' (Nielsen, 1970) which is essentially membranous and has a pair of long, rod-like apodemal sclerites to which the retractile muscles are probably

attached (Fig. 17). Segment IX often bears an anterior ventral sclerite, termed by Nielsen (1970) the 'dorsal plate' (Fig. 17), and the distal end of the segment forms the lower lip of the genital opening. Segment X is greatly reduced and forms the fleshy upper lip of the gonopore; it also bears a pair of short, one-segmented cerci.

In preparations of female abdomens the form of the posterior, partly sclerotized genital ducts ('internal apparatus', Nielsen, 1970) may be more or less discernible, the most noticeable structures being the sclerites of the vaginal wall (Fig. 17). These are what Mosely (1939a) termed the 'trident-like' structures and they are often erroneously referred to as the 'bursa' or 'bursa copulatrix' which are terms indiscriminately used to refer to almost any part of the internal female reproductive system visible in preparations. Such vaginal sclerites, however, along with the dorsal and ventral plates and the posterior margin of segment VIII provide useful specific characters which, I believe, could be put to more use in the future.

The generalized oviscapt form appears to have been modified in certain genera such as *Oxyethira* (Fig. 121) and *Orthotrichia* (Fig. 134) where the genitalia are reduced and specialized in that they are non-retractile and therefore do not have an oviscapt function. Both forms are described in the systematic account and it is possible that their modifications are associated with the oviposition habits of the females which have not, however, been investigated here.

Larva

The family Hydroptilidae is perhaps the most diverse of the Trichoptera with regard to the form of the larvae and their cases since they are structurally adapted to suit a wide range of aquatic environments. The members of the family do, however, share a number of basic morphological and behavioural features which distinguish them from all other Trichoptera and have led to the inclusion of the Ptilocolepinae within the group. Nielsen's (1948) classic work on hydroptilid larvae unfortunately tends to give a restricted view of the family since it deals with only five of the more advanced genera, namely *Agraylea*, *Hydroptila*, *Oxyethira*, *Orthotrichia* and *Ithytrichia* which are all specialized members of the Hydroptilinae. However, Nielsen (1948) does provide an excellent foundation for all studies, whether morphological, biological or behavioural, on the Hydroptilidae and without it the following more general account would have been almost impossible to conceive.

The following account has been based on the literature and on the examination of material in the BMNH or loaned from various institutions. The genera which are known in their larval stages are given below (brackets signify a proposed synonym of the preceding genus; a single asterisk, *, indicates material examined; two asterisks, **, denote a previously undescribed genus).

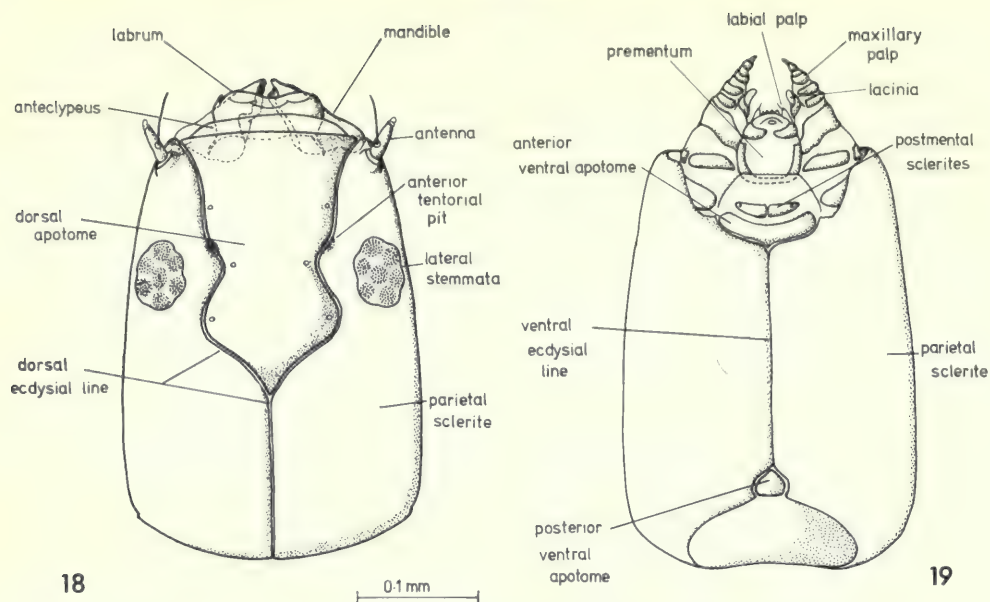
Ptilocolepinae: *Ptilocolepus*, *Palaeagapetus**. Hydroptilinae: *Stactobia**, (*Lamonganotrichia*), *Plethus*, *Stactobiella**, *Catoxyethira*, *Leucotrichia**, *Zumatrichia*, *Peltopsyche*** (previously known from case only), *Anchitrichia*, *Alisotrichia*, *Neotrichia**, *Mayatrichia**, *Agraylea**, *Allo-trichia*, *Ugandatrichia*, *Hydroptila**, (*Oeceotrichia*, *Pasiotrichia*, *Sumatranotrichia*), *Oxyethira**, *Paroxyethira*, *Xuthotrichia*, *Tricholeiochiton**, *Ithytrichia**, (*Sarangannotrichia*), *Orthotrichia**, (*Javanotrichia*, *Baliotrichia*, *Orthotrichiella*), *Dibusa**, *Caledonotrichia***, *Dicaminus* (case only).

A characteristic feature of the family is that the larvae undergo a simple form of hypermetamorphosis in which instars I–IV ('young larvae') are minute, free-living, caseless and of very short duration, while the fifth instar ('old larva') builds a portable or secondarily fixed case and is the principal feeding and growing stage of the life-cycle. The following account of the general external appearance of hydroptilid larvae refers only to the fifth instar; the earlier instars will be discussed later.

General appearance

Despite their case building habits, hydroptilid larvae are prognathous and campodeiform as are the more primitive, free-living and 'saddle-case' bearing groups in comparison with the hypognathous, eruciform, 'tube-case' building limnephiloid groups.

The Hydroptilidae may be distinguished from all other caddis larvae by a combination of the following characters: small size (2.0–7.0 mm body length), enlarged abdomen, three pairs of well-developed thoracic tergites, the absence of segmentally arranged tracheal gills and the fusion of the



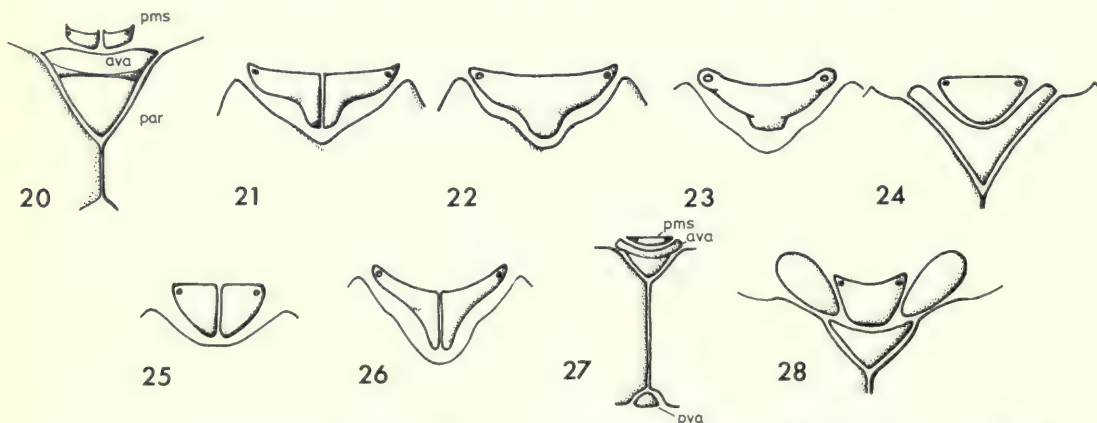
Figs 18–19 Larva, generalized head. 18, dorsal view; 19, ventral view. (Terminology after Hinton, 1963.)

abdominal prolegs to the sides of segment X. The number of abdominal tergites is variable but there is always one on segment IX (the 'anal plate') and in the Hydroptilinae there is usually a pair of small sclerotized (sometimes fused) 'rings' on the terga of segments II/III to VII/VIII.

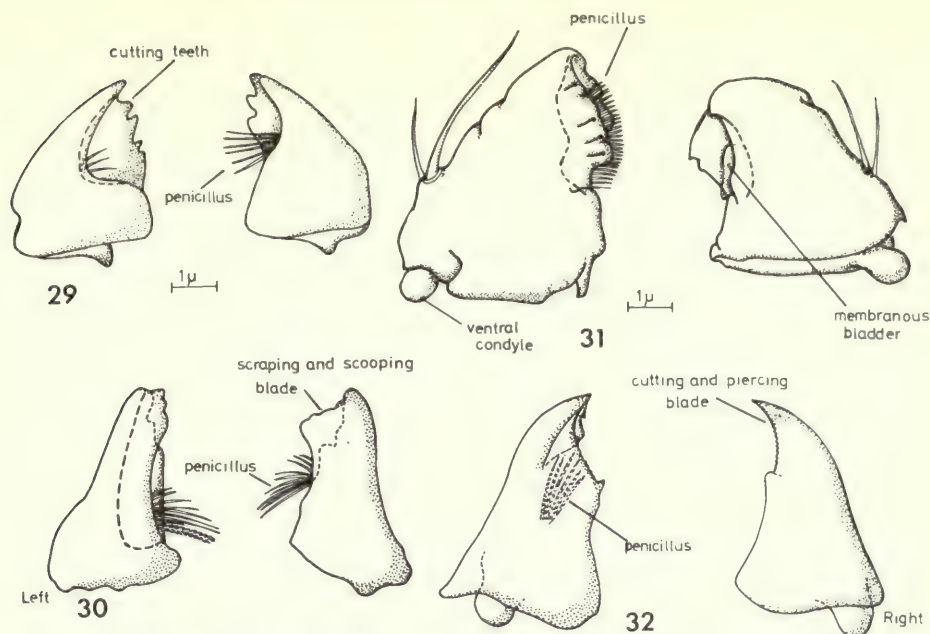
A detailed account of the external morphology of hydroptilid larvae will not be given here; for this, reference should be made to Nielsen (1948). However, features of taxonomic importance or over which there has been some controversy regarding nomenclature will be briefly mentioned below.

Head capsule

There has been some confusion over the homologies of the various regions of the head capsule of trichopteran and endopterygote larvae in general, especially with respect to the ventral sclerites



Figs 20–28 Ventral apotomes and postmental sclerites, larva. 20, *Palaeagapetus celsus* Ross; 21, *Agraylea sexmaculata* Curtis; 22, *A. multipunctata* Curtis; 23, *Tricholeiochiton fagesii* (Guinard); 24, *Ithytrichia lamellaris* Eaton; 25, *Stactobia caspersi* Ulmer; 26, *Hydroptila occulta* (Eaton); 27, *Oxyethira flavicornis* (Pictet); 28, *Orthotrichia costalis* (Curtis). (ava, pva, anterior and posterior ventral apotomes; par, parietal sclerites; pms, postmental sclerites.)



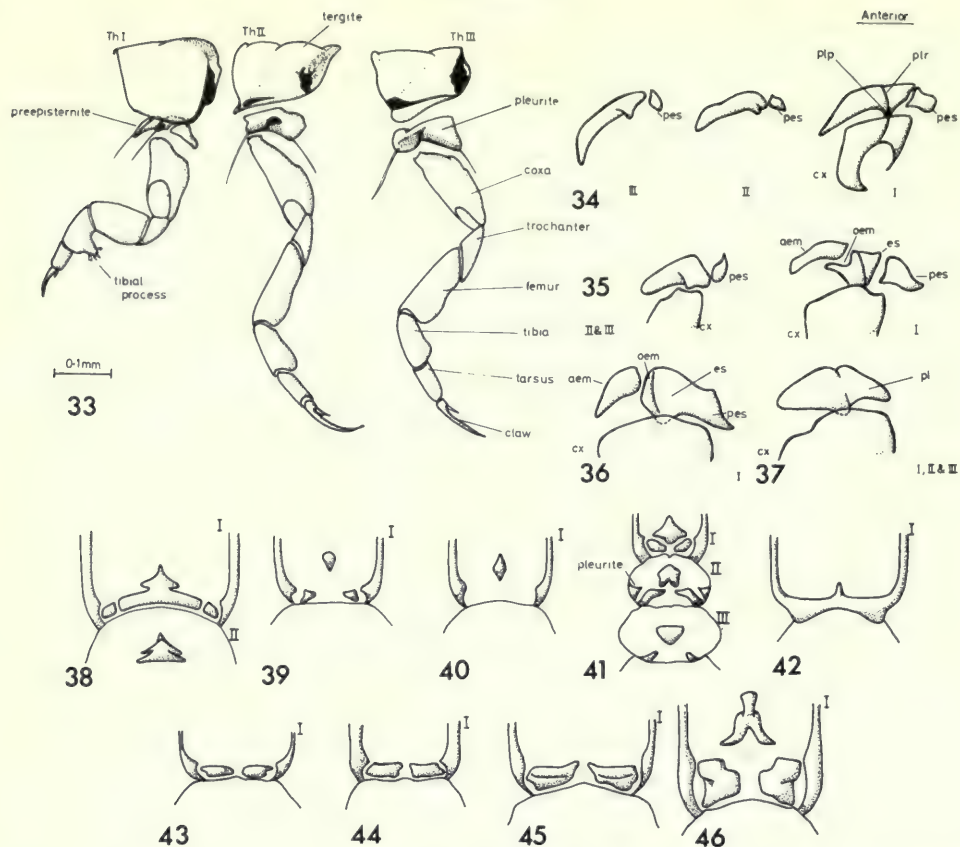
Figs 29–32 Mandibles, larva. 29, *Palaeagapetus celsus* Ross (after Flint, 1962); 30, *Stactobia caspersi* Ulmer (after Botosaneanu, 1956); 31, *Hydroptila occulta* (Eaton); 32, *Orthotrichia costalis* (Curtis) (after Nielsen, 1948).

and the maxillolabial and hypopharyngeal complex. For simplification the terminology proposed by Hinton (1963) has been adopted here and is illustrated in Figs 18, 19. The variety of ventral apotomes and postmental sclerites found within the family is shown in Figs 20–28. The mouth-parts are of the mandibulate type and were probably basically suited for biting through vegetable material as in the Ptilocolepinae (Fig. 29) but, within the Hydroptilinae, two main lines of feeding adaptations may be traced. In the Stactobiini and Leucotrichiini the larvae are primarily detritus-feeding and the mandibles tend to have a form suited to scraping the substrate and scooping up diatoms and other small organic particles (e.g. Fig. 30). In the Hydroptilini and *Orthotrichia*, however, the larvae feed on the fluids of green filamentous algae and the mandibles are adapted for biting or piercing a hole in the cell wall (Figs 31, 32). The mandibles are basically short and robust and one or both may bear a tuft of hair-like spinules (the 'penicillus') in the median concavity and which, as in *Hydroptila occulta* (Eaton), for example (Fig. 31), may be replaced in one mandible by a small, membranous 'bladder'. The form of the mandibles may provide useful generic or specific characters but it should always be borne in mind that such structures may be worn down with age and hence lose some of their external sculpturing.

Thorax

Well-developed tergites are present on all three thoracic segments and each has a distinct mesal suture which, in the prothorax, probably serves as an ecdysial line (Fig. 33). Pleurites are present on all three segments and essentially consist of the fused episternite (*es*) and epimeron (*aem*, *oem*) (collectively termed the 'pleurite') separated by the raised pleural ridge (*plr*) which continues ventrally as a short pleural process and articulates with the antero-lateral coxal process (*vide* Fig. 34). A small anterior sclerite derived from the episternite (the preepisternite) may also be present. The various forms of the pleurites found in hydroptilid larvae are shown in Figs 34–37. The thoracic sternites are shown in Figs 38–46.

The thoracic legs of fifth instar hydroptilid larvae are basically of the ambulatorial type which may be modified as short, robust clinging organs in torrenticolous forms (e.g. Fig. 85) or as long, slender appendages in vegetation-dwellers (Figs 123, 132). The general form is shown in Fig. 33,

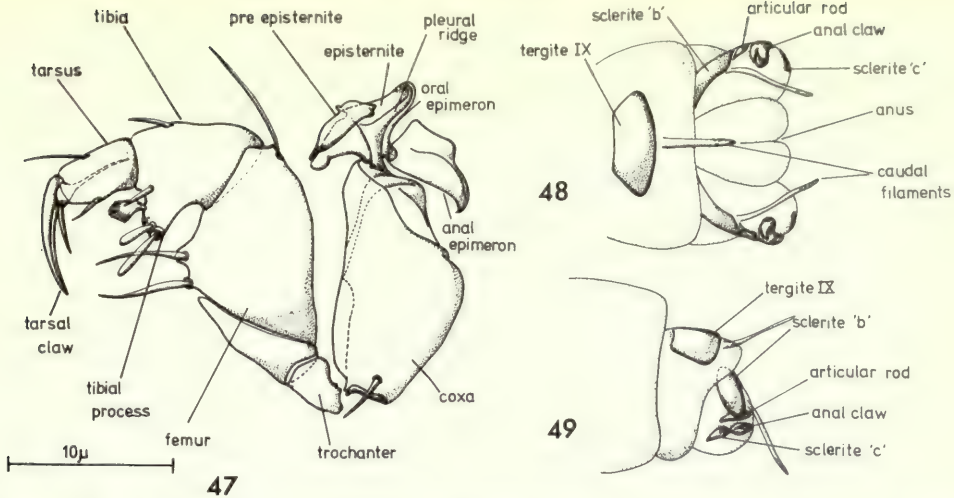


Figs 33–46 Thorax, larva. 33, thorax and legs, *Hydroptila* sp., lateral view. 34–37, thoracic pleurites, lateral view, (34) *Palaeagapetus celsus* Ross; (35) *Agraylea multipunctata* Curtis; (36) *Oxyethira flavicornis* (Pictet); (37) *Dibusa angata* Ross (aem, analepimeron; cx, coxa; es, episternite; oem, oral epimeron; pl, pleurite; plp, pleural process; plr, pleural ridge; pes, preepisternite.) 38–46, thoracic sternites; (38) *Stactobia caspersi* Ulmer; (39) *Hydroptila occulta* (Eaton); (40) *Agraylea multipunctata* Curtis; (41) *Oxyethira flavicornis* (Pictet); (42) *Ithytrichia lamellaris* Eaton; (43) *Plethus* sp.; (44) *Ochrotrichia* sp.; (45) *Caledonotrichia* sp.; (46) *Tricholeiochiton fagesii* (Guinard).

the foreleg always being the shortest and sometimes adapted for special feeding or case-construction purposes. In *Agraylea*, *Oxyethira*, *Paroxyethira* and *Hydroptila* the foreleg (Fig. 47) possesses a distinct modified seta-bearing process against which, according to Nielsen (1948), the tarsal claw may be apposed thus forming a specialized chelate organ used in the manipulation of algal filaments. In general, features of the legs of hydroptilid larvae often provide useful taxonomic characters, especially at the generic level.

Abdomen

In fifth instar, case-bearing hydroptilid larvae, this is uniquely distended in shape and its overall form is usually characteristic for each genus. There are ten distinct segments (XI regarded as being fused with X) which are usually membranous except for the tergite of segment IX; segment X always bears a pair of well-developed anal prolegs which are usually fused to the sides of the segment in case-bearing larvae but project from the sides of the body in free-living forms and in the 'tube-case' building Neotrichiini (Figs 48, 49, cf. 50, 51, 92, 106). In *Hydroptila* and *Ithytrichia* (Figs 48, 49, 118, 141) long filiform caudal filaments are present arising on segments IX and X. Hydroptilinae larvae have dorsal sclerotized rings on abdominal segments II/III to VII/VIII which seem to be a constant feature of the subfamily (Figs 74, 97, 110, 118, 123, 132, 136, 141,



Figs 47–49 Larval thoracic leg and anal prolegs (fifth instar). 47, foreleg and pleurites, *Hydroptila* sp. 48–49, anal prolegs, generalized hydroptilid, (48) dorsal view; (49) lateral view.

143, 147). Nielsen (1948) referred to them as 'dorsal abdominal glands' but they do not appear to have a glandular structure internally and simply appear to be modified epithelial cells. According to Wiggins (1977) they may be regions of specialized chloride epithelial cells adapted for ionic absorption and osmoregulation.

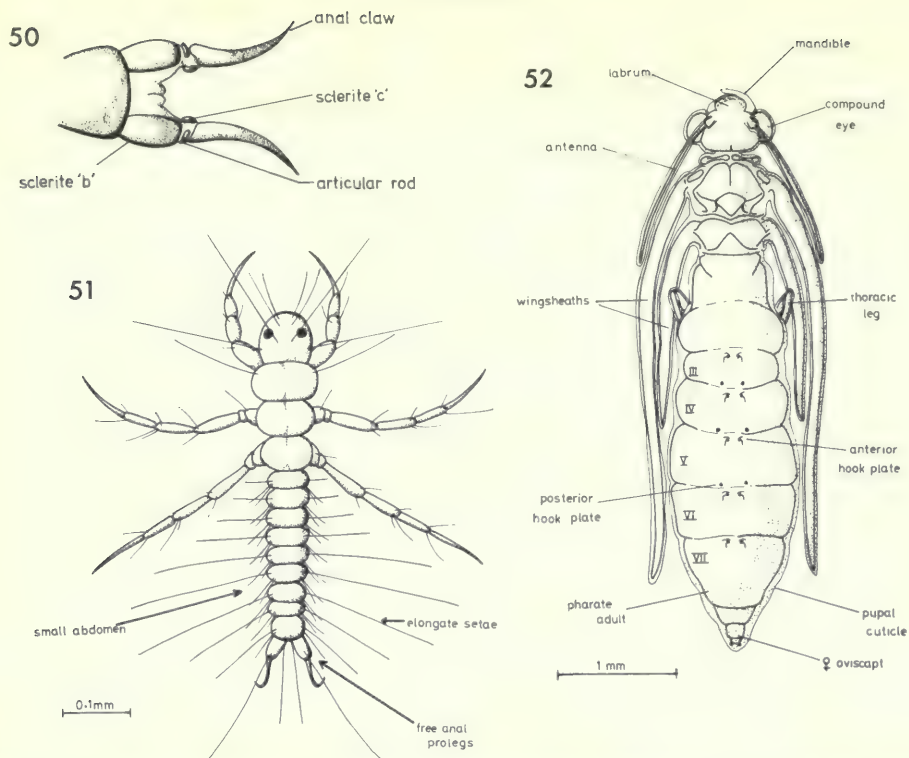
Case

Final instar hydroptilid larvae construct distinctive cases of silk secretion which may be externally sculptured or into which may be incorporated various organic or inorganic particles such as bryophyte fragments, algal filaments and diatoms or small sand grains (which may be added to provide ballast). Ross (1967) coined the term 'purse-case' to distinguish hydroptilid cases from the 'saddle-cases' of the Glossosomatidae and the 'tube-cases' of the higher limnephiloid groups. The 'purse-case' essentially consists of two silken 'valves' closely apposed and joined along the lateral margins (seams) leaving slit-like anterior and posterior openings. It may be laterally (Figs 79, 98, 111, 119, 123, 128, 132, 145) or dorso-ventrally (Fig. 61) compressed and in the latter instance may be temporarily or permanently fixed to the substrate (Figs 75, 76, 78, 81, 86, 148) or it may have a more fusiform shape (Figs 99, 138). As the abdomen of the fifth instar larva increases in size the larva enlarges the case by splitting the dorsal and ventral seams and adding new layers of silk before closing them again (Nielsen, 1948). The Neotrichiini are distinct in having slightly tapering 'tube'-type cases (Figs 103, 107) with circular oral and anal apertures, thus superficially resembling the higher Limnephiloidea. *Alisotrichia* (Leucotrichiini) and *Ugandatrachia* (Hydroptilini) are distinct in that the final instar appears to have lost its case building habit and consequently retains the general appearance of the free-living early instars. The cases of the Hydroptilidae are very distinct for each genus and provide very useful key characters.

The 'young larvae': instars I–IV

Larval hypermetamorphosis is characteristic of the Hydroptilinae, although it has not yet been observed in the Ptilocolepinae, and has so far been recorded in *Agraylea*, *Hydroptila*, *Oxyethira*, *Ithytrichia*, *Orthotrichia* (vide Nielsen, 1948); *Stactobia* (Botosaneanu, 1956; Danecker, 1961; Lepneva, 1964); *Ochrotrichia*, *Mayatrachia* (Ross, 1944), *Paroxyethira* (Leader, 1970) and *Ugandatrachia* (Scott, 1976).

The young larvae are characterized by their relatively smaller size (0.5–2.7 mm, I–early V) and features associated with the absence of a case. They thus have narrow posteriorly tapering abdomens and long, freely projecting anal prolegs while the whole body is covered in long, fine setae



Figs 50–52 Early instars and pupa. 50, anal prolegs, early instar, dorsal view; 51, generalized early instar, dorsal view; 52, pharate adult ('pupa'), *Hydroptila vectis* Curtis, ♀, dorsal view.

which give them the appearance of small, planktonic Crustacea (Fig. 51). The setae offer resistance to sinking and aid the larvae in remaining suspended in the water and in swimming, these instars being the dispersive stages of the larval life-history. In those genera which live in rapids and torrents the larvae are more robust and dorso-ventrally flattened with short legs and few setae, thus being adapted for moving over the surface of the substrate rather than swimming freely. A more detailed account of the early instars is given by Nielsen (1948) who describes both their morphology and their behaviour.

Pupa

The general appearance of the exarate, denticous pupae of most Trichoptera is very uniform throughout the order and the cast pupal skins are difficult to identify beyond the family level. Hydroptilid pupae may be recognized by their lack of any positive distinguishing structural features which variously characterize the other families of Trichoptera. In addition to their relatively small size (1.5–6.0 mm body length), the following features are useful in recognizing hydroptilid pupae (Fig. 52): (i) absence of abdominal gills or lateral lines; (ii) presegmental dorsal abdominal plates on segments III–VII, postsegmental plates on segments III–V; (iii) mandibles symmetrical, short with one or two small median teeth or long or short without teeth or with a fine, serrate cutting edge; (iv) anal seta-bearing processes absent (these only occur in forms where the posterior end of the pupal case is open to admit a water current, the setate processes serving to keep the apertures clear of debris).

Finally, the pupal case generally resembles that of the larva except that the oral and anal apertures are sealed and it is fixed to the substrate. Having attached and sealed the case, the larva then spins the final internal lining and adopts the characteristic prepupal resting attitude in which, according to Barnard (1971), the thorax becomes distended, the abdomen straightens and the

intersegmental grooves become less distinct. According to Nielsen (1948) there is a distinct anterior and posterior differentiation of the larval case and this becomes reversed in the pupal stage. When the pharate pupa is fully developed, ecdysis takes place and the larval exuviae are pushed to the posterior end of the pupal case. The fully developed pharate adult cuts an exit hole in the pupal case and wriggles out with the aid of the dorsal abdominal hook plates. It then makes its way to the surface where it swims around erratically, back uppermost, until it encounters a support on which it climbs out of the water and rests before the final ecdysis.

Systematics

Family HYDROPTILIDAE Stephens

Hydroptilidae Stephens, 1836 : 151. Type-genus: *Hydroptila* Dalman, 1819.

DISTRIBUTION. Cosmopolitan (excluding polar regions).

DIAGNOSIS. *Adult* (Fig. 1) Forewing length 1.2–6.0 mm; forewings moderately to densely pubescent; wings broad with relatively complete venation in the more primitive Ptilocolepinae (Fig. 5) to narrow with highly reduced venation and tapering apices in the more advanced Hydroptilinae (Figs 6–10); ocelli 3, 2 or 0, lateral pair set close to compound eyes some distance posterior to antennal bases; post-occipital warts prominent, meeting postero-medially or represented by loosely hinged sclerites or 'lobes' (Fig. 114); ♀ genitalia usually an oviscap with an elongate telescopic segment IX and a small, cerci-bearing segment X (Fig. 17) (IX rarely reduced and fixed (e.g. Fig. 121)); ♂ inferior appendages one-segmented, genitalia otherwise very variable (generalized plan, Fig. 15).

Larva (e.g. Fig. 118). Campodeiform, prognathous; usually exhibiting hypermetamorphosis; dorsa of all three thoracic segments with paired nota; abdominal gills and lateral line absent; anal prolegs usually fused to sides of segment X in the fifth instar (free in instars I–IV); abdominal tergites present or absent on segments I–VIII, always present on segment IX; dorsa of abdominal segments I–VIII variously with small cuticular rings which may be regions of chloride epithelia; abdomen usually greatly distended in fifth instar; case basically of 'purse-type' (e.g. Fig. 119).

Pupa (Fig. 52). Mandibles usually short with one or two small median teeth (Ptilocolepinae) or with fine serrations along inner edge only (Hydroptilinae); abdominal gills and lateral line absent; apex of abdomen without lobes, processes or specialized cleaning appendages; presegmental hook plates present dorsally on abdominal segments III–VII, postsegmental plates on III–V.

Keys to genera

Adult

- 1 Forewings broad with rounded apices, sparsely pubescent, fringes relatively short; venation well developed, discoidal cell (*dc*) present, *Cu*₁ forked in forewing (Fig. 5); mesonotum convex, prescutum distinct, scutellum subtriangular with a straight posterior margin and a large oval wart (Fig. 53); mesokatepisternal suture (Fig. 3, suture 'k') present; latero-ventral ridge of abdominal sternite V present (with or without a pair of antero-dorsal filaments) (Fig. 11) (Ptilocolepinae) 2
- Forewings narrow, usually acuminate, densely pubescent, fringes long (Fig. 1); venation variable, usually reduced (Figs 6–10), forewing with *Cu*₁ unbranched; mesonotum flat, prescutum absent, scutellum with posterior section forming a flat triangular area with steep sides and a warty texture along edges only (e.g. Figs 62, 114); mesokatepisternal suture absent (Fig. 3, inset); sternite of abdominal segment V with a pair of shallow antero-dorsal pits, each with a short, setae-bearing digitate process (Figs 12–14) (Hydroptilinae) 3
- 2 Veins *R*₂, *R*₃, *M*₁, *M*₂ free in the hindwing; spur formula 2.4.4 (North America; Baltic Amber) *PALAEAGAPETUS* (p. 160)
- Veins *R*₂ + *R*₃, *M*₁ + *M*₂ fused in the hindwing (Fig. 5); spur formula 1.3.4 (Palearctic) *PTILOCOLEPUS* (p. 160)
- 3 Transverse suture present on mesoscutellum (Figs 62, 83, 93) 4
- Transverse suture absent on mesoscutellum (e.g. Figs 108, 114, 120) 20
- 4 Metascutellum subpentagonal to triangular (Figs 83, 93) (Nearctic and Neotropical) 10
- Metascutellum subrectangular to short pentagonal (Palearctic) or as wide as scutum, very short and rectanguloid (Figs 62–64) (Holarctic) 5

- 5 Metascutellum as wide as scutum, short and subrectangular (Fig. 62) 6
 – Metascutellum not as wide as scutum (Figs 63, 64) 8
 6 Spur formula 0.2.4
 (Oriental) *CHRYSOTRICHIA* (p. 170) (Neotropical: Antilles) *BREDINIA* (p. 170)
 – Spur formula 1.3.4 7
 7 ♂ genitalia simple, segment VIII unmodified (Fig. 65) (Holarctic) *STACTOBIELLA* (p. 169)
 – ♂ genitalia very complex, sternite VIII elongate with posterior dorso-lateral spines, segment IX much reduced and withdrawn into VIII (Fig. 68) (Africa) *CATOXYETHIRA* (p. 171)
 8 Spur formula 0.2.3 (SE. Asia) *PLETHUS* (p. 168)
 – Spur formula 1.2.4 9
 9 Fore-tibial spur reduced to a small process; postoccipital lobes narrow, elongate; metascutellum wide, short, rectangular to pentagonal (Fig. 64); ♂ genitalia very complex; ♀ internal apparatus with distinct loop in anterior duct (Fig. 82) (Africa; SE. Asia ?)
 MADIOXYETHIRA (p. 173) (possibly including *PSEUDOXYETHIRA* (p. 174) and *SCELOTRICHIA* (p. 174))
 – Fore-tibial spur unmodified; postoccipital lobes broad, hemispherical; metascutellum narrow, long, rectangular (Fig. 63); ♂ genitalia relatively simple, sternite VIII produced postero-ventrally, IX reduced, VII with elongate process (Fig. 66); ♀ internal apparatus without anterior loop (Palearctic) *STACTOBIA* (p. 165)
 10 ♂ inferior appendages large and distinct, projecting well beyond segment IX, often armed with various spines and processes (Figs 94–96); head and antennae always simple (Fig. 93) 11
 – ♂ inferior appendages usually short, hardly projecting beyond segment IX (Fig. 84) but if narrow and elongate with elaborate baso-dorsal processes then head and antennae (♂) modified (Figs 90, 91) 13
 11 Fore-tibia without apical spur *OCHROTRICHIA* (*OCHROTRICHIA*) (p. 186)
 – Fore-tibia with apical spur 12
 12 ♂ segment IX produced posteriorly as broad dorso-lateral lobes; inferior appendages narrow, elongate, projecting ventrally just beyond lobes of IX *RHYACOPSYCHE* (p. 187)
 – ♂ segment IX without lateral lobes, inferior appendages broad and elongate, projecting well beyond IX (Fig. 94) *OCHROTRICHIA* (*METRICHIA*) (p. 186)
 13 Spur formula 0.3.4; 0.2.4; 0.2.3; ♂ aedeagus with median constriction only; ♀ tergite VII modified, internal apparatus simple, ring-like *ALISOTRICHIA* (p. 183)
 – Spur formula 1.3.4; ♂ aedeagus with midlength complex (Fig. 84); ♀ tergite VII unmodified, internal apparatus well developed (*Leucotrichia*-group) 14
 14 Basal costal pouch present on ♂ forewing (Figs 9, 10) 15
 – Basal costal pouch absent on ♂ forewing 17
 15 Basal costal pouch large, almost half length of forewing (Fig. 9); head and basal antennal segment (♂) complex (Fig. 91); ocelli 2 (♂) *ABTRICHIA* (p. 183), *Betrichia bispinosa* (p. 182)
 – Basal costal 'bulla' small (Fig. 10); head and basal antennal segment (♂) unmodified; ocelli 3 16
 16 Middle antennal segments (♂) wide and flat (Fig. 90). *COSTATRICHIA* (*Iodora*-group) (p. 181)
 – Middle antennal segments (♂) unmodified *ACOSTATRICHIA* (p. 182)
 17 Basal segment of ♂ antenna enlarged *PELTOPSYCHE* (p. 179), *ZUMATRICHIA* (p. 179)
 – Basal segment of ♂ antenna unmodified 18
 18 Ocelli 3 (♂, ♀)
 COSTATRICHIA (*simplex*-group) (p. 181), *Betrichia argentinica* (p. 182),
 LEUCOTRICHIA (*melleopicta*-group) (p. 178) and *CELAENOTRICHIA* (p. 183)
 – Ocelli 2 (♂) 19
 19 ♂ abdominal sternite VIII with postero-lateral processes *ANCHITRICHIA* (p. 181)
 – ♂ abdominal sternite VIII unmodified
 LEUCOTRICHIA (*pictipes*-group) (p. 178) and *BETRICHIA* (partim) (p. 182)
 20 Ocelli absent 21
 – Ocelli present 23
 21 Fore-tibia with apical spur; wings elliptical, ovoid; insect large (forewing length 5.5 mm) (Nearctic) *DIBUSA* (p. 218)
 – Fore-tibia without apical spur; wings acuminate 22
 22 Metascutellum subrectangular (Fig. 133); spur formula 0.3.4; ♂ genitalia markedly asymmetrical (Fig. 135); ♀ genitalia with segment IX relatively short (Fig. 134)
 ORTHOTRICHIA (p. 213)

- Metascutellum pentagonal to triangular; spur formula 0.2.4; ♂ genitalia symmetrical; segment IX of ♀ long, forming an oviscapt; postoccipital lobes of ♂ modified as hinged caps concealing eversible scent organs *HYDROPTILA* (p. 200)
- 23 Mid-tibia with no preapical spur (0.2.3, 0.2.4) 24
- Mid-tibia with preapical spur (1.3.4, 0.3.4) 27
- 24 Spur formula 0.2.3 (Nearctic) *NEOTRICHIA* (p. 189)
- Spur formula 0.2.4 25
- 25 ♂ segment VIII fused, annular; segment IX almost entirely concealed within VIII; forewing length c. 1.6 mm (SE. Asia) *STENOXYETHIRA* (p. 207)
- ♂ genitalia not as above 26
- 26 ♂ segment IX with prominent postero-lateral processes and broad apices; inferior appendages with broad setae-bearing posterior margin and small digitate dorso-lateral basal projection (Nearctic, Neotropical) *MAYATRICHIA* (p. 191)
- ♂ segment IX without processes, inferior appendages apparently absent (Australia) *ORPHNINOTRICHIA* (p. 220)
- 27 Fore-tibia with apical spur (Neotropical: Chile) *NOTHOTRICHIA* (p. 219)
- Fore-tibia without apical spur 28
- 28 Mesoscutellum diamond shaped, narrow (Figs 108, 112, 113) 29
- Mesoscutellum with anterior margin evenly convex, wide (Figs 120, 126, 130, 139) 32
- 29 ♂ ventral process of sternite VII short, laterally compressed, triangular; inferior appendages large, elongate, often broad 30
- ♂ ventral process of sternite VII usually long and spatulate; inferior appendages short and broad, sometimes with short postero-median processes 31
- 30 Lateral filaments of abdominal segment II present in ♂ (India, SE. Asia) *UGANDATRICHIA (MOSELYELLA)* (p. 198)
- Lateral filaments absent (Africa) *UGANDATRICHIA (UGANDATRICHIA)* (p. 198)
- 31 ♂ inferior appendages with concave posterior margins; subgenital plate with a pair of asymmetrical processes bearing asymmetrical spines or filamentous appendages (Fig. 109) *ALLOTTRICHIA* (p. 196)
- ♂ inferior appendages with convex posterior margins (*sexmaculata*-group) or very short with postero-median processes (*multipunctata*-group); processes of subgenital plate absent *AGRAYLEA* (p. 193)
- 32 ♂ abdominal segment VIII fused, annular; segment IX mostly concealed within VIII (Fig. 122); ♀ genitalia not oviscapt, segment IX reduced, tergite usually fused with that of VIII (Fig. 121) *OXYETHIRA* (p. 203)
- ♂ segment VIII with tergite and sternite distinct; ♀ genitalia usually oviscapt 33
- 33 ♂ genitalia very distinctive, sclerites VII and VIII reduced to thin strips, sternite IX enlarged, tergite X forming an elongate narrow plate, inferior appendages short, slender with incurved apices (Sri Lanka) *MACROSTACTOBIA* (p. 217)
- ♂ genitalia not as above 34
- 34 ♂ segment IX with deep dorsal U-shaped incision revealing aedeagus in distinct sheath usually with subapical processes; inferior appendages elongate, concave, broad; ventral processes on segments VII and VIII, latter long and spatulate (Fig. 127) (New Zealand) *PAROXYETHIRA* (p. 208)
- ♂ genitalia not as above 35
- 35 ♂ segment IX produced postero-ventrally (obliquely truncate in lateral view); genital appendages concealed within IX, difficult to homologize (Fig. 131) (NW. Palearctic, SE. Asia) *TRICHOLEIOCHITON* (p. 210)
- ♂ genitalia not as above 36
- 36 ♂ sternite VI with ventral process; sides of segment IX tapering postero-medially; inferior appendages elongate, parallel, arising near antero-ventral margin of IX, scarcely projecting posteriorly beyond IX (Fig. 140) *ITHYTRICHIA* (p. 216)
- ♂ genitalia not as above 37
- 37 ♂ inferior appendages apparently arising dorso-posteriorly from segment IX, 'bean-shaped' with distinct ventrally directed processes; aedeagus slender, tapering (New Caledonia) *CALEDONOTRICHIA* (p. 221)
- ♂ genitalia not as above 38
- 38 ♂ sternite VII with long, slender process; segment IX with broad postero-lateral truncate side-pieces; aedeagus with distinct apical or sub-apical hook (Fig. 129) (Australia) *XUTHOTRICHIA* (p. 209)

- ♂ genitalia not as above 39
- 39 ♂ segment IX with postero-lateral side-pieces produced as broad, truncate lobes, segment IX reduced dorsally to thin median transverse strip; aedeagus truncate with well-developed spiral 'titillator' (Yemen, Africa, Zaire) *DHATRICHIA* (p. 199)
- ♂ segment IX relatively complete dorsally; aedeagus slender with pointed apex or short, spiral 'titillator' (Europe, Pakistan, Aden) *MICROPTILA* (p. 197)
- Larva**
- 1 Small tergites present on abdominal segments I–VIII; larval case dorso-ventrally flattened, fixed to substrate or absent 2
- Segments I–VIII without distinct tergites; larval case variable but usually not fixed to substrate 9
- 2 Median sutures of meso- and metathoracic nota indistinct (Nearctic, Neotropical) 6
- Median sutures of all three thoracic nota distinct 3
- 3 Fifth instar larva free-living, without case; pupal case sac-like (Africa) *UGANDATRICHIA* (p. 198)
- Fifth instar larva with distinct case 4
- 4 Posterior margin of fourth tergite appearing 'crenellated'; case dorso-ventrally flattened, barrel-shaped with mid-dorsal and ventral longitudinal seams (Figs 74, 75) *STACTOBIA* (p. 165)
- Tergite IX of larva and case not as above 5
- 5 Case rectangular in dorsal view (Fig. 78) with mid-dorsal and ventral seams; larva (Fig. 77) (SE. Asia) *PLETHUS* (p. 168)
- Case tapering anteriorly and posteriorly (Fig. 81) without dorsal and ventral seams (Africa) *CATOXYETHIRA* (p. 171)
- 6 Fifth instar larva free-living, without case; abdomen slender, tapering posteriorly; anal prolegs projecting from sides of abdominal segment X (Fig. 92) *ALISOTRICHIA* (p. 183)
- Fifth instar in a fixed, oval-circular case, abdomen enlarged, abruptly widened from segments V–VII; anal prolegs fused to sides of segment X 7
- 7 Anterolateral angle of pronotum produced anteriorly; femora with arborescent setae *ANCHITRICHIA* (p. 181)
- Anterolateral angle of pronotum not produced; arborescent setae absent 8
- 8 Tergite IX with short, stout scattered setae (*vide* Figs 87–89) *ZUMATRICHIA* (p. 179), *ABTRICHIA* (p. 183), *PELTOPSYCHE* (p. 179)
- Tergite IX usually without short, stout setae but if present then in a transverse band (*vide* Figs 85, 86) *LEUCOTRICHIA* (p. 178)
- 9 Mid- and hindlegs slender, much longer than forelegs 10
- Thoracic legs short, subequal in length 12
- 10 Case 'bottle'- or 'jug'-shaped (Figs 123, 124) *OXYETHIRA* (p. 203)
- Long edges of case almost parallel 11
- 11 Mid- and hindlegs greater than 4 × forelegs (Fig. 132) *TRICHOLEIOCHITON* (p. 210)
- Mid- and hindlegs approximately 2.5 × forelegs (Fig. 128) (New Zealand) *PAROXYETHIRA* (p. 208)
- 12 Abdominal segments with dorsal and ventral 'bud-like' processes; a single filamentous caudal gill present (Fig. 141) *ITHYTRICHIA* (p. 216)
- Abdominal segments not as above, caudal filaments usually absent 13
- 13 Abdomen more or less cylindrical; head tapering anteriorly; anal prolegs not fused to sides of segment X; case cylindrical, tapering posteriorly (Nearctic) 14
- Abdomen flattened dorso-ventrally or -laterally; head not tapering anteriorly; anal prolegs fused to sides of segment X; case flattened with slit-like anterior and posterior openings 15
- 14 Abdomen slightly depressed, intersegmental grooves prominent; case of secretion and fine sand grains (Figs 102–104). *NEOTRICHIA* (p. 189)
- Abdomen not depressed, intersegmental grooves indistinct; case of secretion only, surface sculptured usually with transverse or longitudinal ridges (Figs 105–107) *MAYATRICHIA* (p. 191)
- 15 Labrum with asymmetrical 'beak' (Fig. 137); abdominal segment II with lateral humps (Fig. 136); case fusiform, of secretion only with longitudinal ridges (Fig. 138) *ORTHOTRICHIA* (p. 213)
- Labrum, abdomen and case not as above 16
- 16 Tibia of foreleg with pronounced baso-ventral process 17
- Tibia of foreleg without baso-ventral process 20
- 17 Abdomen with three filamentous caudal gills; case laterally compressed, of two silken valves covered in fine sand grains and diatoms (Figs 118, 119) *HYDROPTILA* (p. 200)

- Caudal gills absent 18
- 18 Ventral intersegmental grooves of abdomen very pronounced; case of two silken valves covered in radially arranged algal filaments (Figs 110, 111) *AGRAYLEA* (p. 193), *ALLOTRICHIA* ? (p. 196)
- Abdomen and case not as above, exclusively 'New World' 19
- 19 Tarsus with large, plate-like seta and hook claw; antero-lateral expansion of metanotum absent; case fusiform, of secretion only (Figs 99, 100) (Central America) *RHYACOPSYCHE* (p. 187)
- Tarsal seta not plate-like; metanotum with antero-lateral expansion; case usually laterally compressed, of two silken valves covered in fine sand grains, sometimes carried horizontally (dorsal valve vaulted, ventral face flat, of secretion only) (Figs 97, 98) *OCHROTRICHIA* (p. 185)
- 20 Abdomen and case compressed dorso-ventrally 21
- Abdomen and case not compressed dorso-ventrally; tarsal claws stout, abruptly curved with thick blunt spur at base 23
- 21 Case of secretion only with a central tubular section surrounded by lateral fringe, former with a pair of small dorsal pores (Fig. 148; larva, Fig. 147) (New Caledonia) *CALEDONOTRICHIA* (p. 221)
- Case of two silken valves covered in fragments of moss and liverwort (Holarctic, montane regions (Ptilocolepinae)) 22
- 22 Abdomen with a pair of lateral tubercles on each segment; abdominal segment I without small tergite (Figs 60, 61) (Holarctic) *PALAEAGAPETUS* (p. 160)
- Abdomen without lateral tubercles; abdominal segment I with small dorsal tergite (Palearctic) *PTILOCOLEPUS* (p. 160)
- 23 Dorsal abdominal setae stout, dorsal rings of abdominal segments distinct; larva feeding on red algae which are incorporated into silken valves of purse-like case; tarsal claw spurs short, thick and blunt (Figs 143-145) (eastern U.S.A.) *DIBUSA* (p. 218)
- Abdominal setae slender, dorsal ridges indistinct; case of two symmetrical silken valves; tarsal claw spurs elongate, thick, blunt (Figs 79, 80) (Holarctic) *STACTOBIELLA* (p. 169)

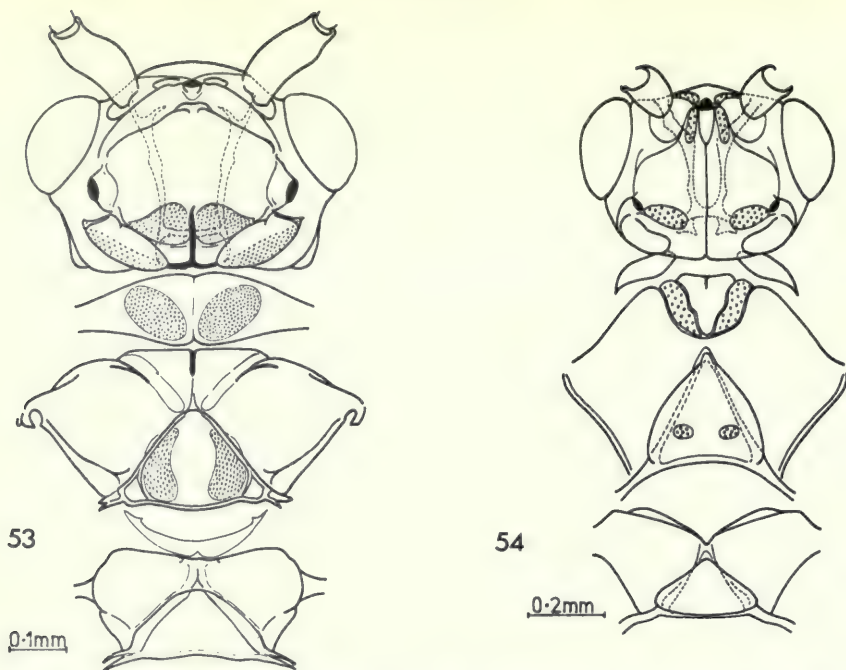
Subfamily **PTILOCOLEPINAE** Martynov

Ptilocolepinae Martynov, 1913a : 22. Type-genus: *Ptilocolepus* Kolenati.

DISTRIBUTION. Holarctic.

The Ptilocolepinae contains two small montane genera which are confined to the Holarctic region. *Ptilocolepus*, containing four extant Palearctic species, and *Palaeagapetus* which is known from the type-species in Baltic Amber and three extant Nearctic species. The adults bear more resemblance to small glossosomatids with which they were once originally classified until discovery of their larval stages indicated that their true affinities were with the Hydroptilidae (Ross, 1956). *Ptilocolepus granulatus* (Pictet) was originally described in *Rhyacophila* but, as Pictet (1834) himself noted, could be distinguished from all other members of the latter genus by its 'rough wings and very ciliated legs'. *Rhyacophila granulata* was later shown to be a senior synonym of *Ptilocolepus turbidus* Kolenati by Hagen (1855), the type-species thus becoming *Ptilocolepus granulatus*. Thienemann (1904) described the larva of *Pt. granulatus* and noted its hydroptilid affinities which prompted Ulmer (1907) to place the genus in the Hydroptilidae. Subsequently, however, Martynov (1913a) erected the Ptilocolepinae for the nominate genus but retained it in the Rhyacophilidae. It was Ross (1956) who finally transferred the subfamily to the Hydroptilidae, redefining it to include the genus *Palaeagapetus* (earlier in that paper, chart 2, p. 18, Ross refers erroneously to the subfamily as the Palaeagapetinae), the inclusion of *Palaeagapetus* later being justified by the discovery of the immature stages of *Palaeagapetus celsus* Ross, described by Flint (1962) and shown to have many affinities with those of *Ptilocolepus granulatus*.

The following subfamily diagnosis is based on the literature and on examination of adult material of *Ptilocolepus granulatus* and *Palaeagapetus celsus* in the BMNH collections and larvae of *P. celsus* loaned from the USNM collection.



Figs 53–54 Adult head and thorax, dorsal view. 53, *Ptilocolepus granulatus* (Pictet); 54, *Agapetus* sp., Glossosomatidae.

DIAGNOSIS. *Adult.* Forewing length 4–6 mm; general body colour dark brown to black, wings somewhat iridescent; wings (Fig. 5) broad with rounded apices, very sparsely pubescent; costal fringes short; venation almost complete, resembling glossosomatid and primitive rhyacophilid conditions in that forewing with discoidal cell (*dc*) closed, *Cu*₁ forked and *Cu*₂ curved: head (Fig. 53, cf. *Agapetus*, Fig. 54) strongly sclerotized, π -shaped tentorium well developed; ocelli 3, lateral pair set close to compound eyes some distance posterior to bases of antennae; antennae short, of approximately 24–30 segments; postoccipital warts large, ovoid, meeting medially; pronotum (Fig. 53, cf. Fig. 54) with median warts close-set; mesonotum strongly convex, prescutum delineated by a row of punctate setal sockets; scutellum subtriangular, convex with a straight posterior margin and a large oval wart; katapisternal suture ('k') present (Fig. 3): metascutellum subtriangular: preapical spur absent from foretibia (spur formula 2.4.4 in *Palaeagapetus* and 1.3.4 in *Ptilocolepus*): abdominal sternite V (Fig. 11) with a well-developed sternal ridge running from anterior dorsal fold, posteriorly and ventrally to meet in midline: ventral processes variously present on sternites VI and VII: ♀ genitalia forming an oviscapt: ♂ genitalia simplified but very specialized within each genus (Figs 55–59) with segment VIII unmodified; segment IX fused, produced antero-ventrally with strongly developed oblique lateral ridges, strongly excised dorsally and ventrally (latter excision containing a triangular ventral plate in *Ptilocolepus* above which lie the fused, generally bifid, 'inferior appendages' (homology uncertain)); 'inferior appendages' apparently fused with segment IX in *Palaeagapetus*; tergite X forming a simple dorsal plate (which in *Ptilocolepus* bears a pair of setose lobes); aedeagus greatly simplified, short, broad and membranous with a dilated apex and a median ventral sclerite.

Larva (Fig. 60). Slightly flattened dorso-ventrally: head with distinct dorsal ecdysial lines; anterior ventral apotome large and triangular, postmental sclerites paired, posterior ventral apotome small and triangular (Fig. 20); labrum symmetrical, anterior margin strongly emarginate with a row of many short setae; mandibles (Fig. 29) not markedly symmetrical, short and stumpy, medial brush present in both right and left, cutting edges strongly ridged: thoracic nota present on all three segments, longitudinal median ecdysial lines distinct on each; thoracic sternites absent; legs short, subequal; preepisternite free on all thoracic segments (Fig. 34); abdomen entirely membranous except for the well-developed tergites of segments I and IX in *Ptilocolepus*; anal prolegs fused to segment X; abdomen with prominent sucker-like tubercles on segments II–VII in *Palaeagapetus*.

Case (Fig. 61). Purse-type, dorso-ventrally compressed (carried horizontally), constructed of two silken valves covered with small fragments of liverwort and moss.

Pupa. Mandibles long with two medial teeth in *Ptilocolepus*, one in *Palaeagapetus*.

BIOLOGY. The larvae occur in small montane springs and seeps, amongst luxuriant growths of moss and liverwort, on stones and other submerged objects; they are often found in the cold damp vegetation above the water level. Habitats in cool, shaded, montane coniferous forests, which favour the growth of bryophytes, are likely to support small colonies of these very local and primitive caddis flies; indeed, McLachlan (1880) noted that the adults of *Ptilocolepus granulatus* were found in European mountainous regions 'on driblets on faces of rocks' where water was soaked up by the moss. The habitat preferences of the Ptilocolepinae are thus very similar to those of the hypothetical ancestral caddis larva as postulated by Ross (1956).

The early stages (instars I–IV) of the Ptilocolepinae have not yet been discovered; the phenomenon of hypermetamorphosis has therefore not been verified in this subfamily.

DISCUSSION. The Ptilocolepinae appear to represent a natural extant link between the primitive Glossosomatidae, with which they share many adult features, and the very specialized Hydroptilinae with which they are classified on the basis of the affinities of the distinctive larvae and their cases. The subfamily is confined to cool Holarctic regions, being found locally in clear, shaded montane springs in association with bryophytes as is typical of the more primitive Trichoptera. The Ptilocolepinae probably thus arose from the main hydroptiline stock very early in the evolution of the family before the typical adult hydroptilid form had been derived. It has since remained very little changed except perhaps with respect to the development of the highly specialized and characteristic male genitalia.

Keys to differentiate the Ptilocolepinae, Glossosomatidae and Rhyacophilidae

Adult

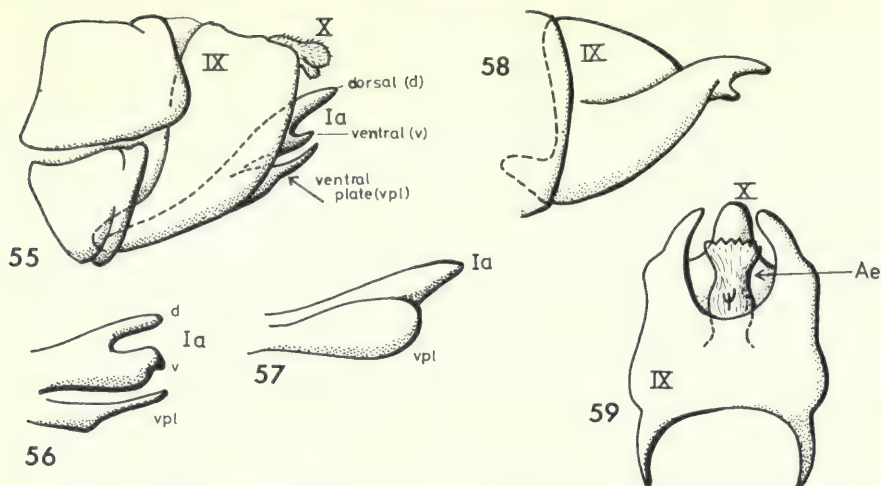
- | | | |
|---|---|-------------------------------|
| 1 | Discoidal cell of forewing open; spur formula 3.4.4 | RHYACOPHILIDAE |
| – | Discoidal cell of forewing closed (Fig. 5, <i>dc</i>); spur formula 2.4.4 or 1.3.4 | 2 |
| 2 | Spur formula 1.3.4 | PTILOCOLEPUS (p. 160) |
| – | Spur formula 2.4.4 | 3 |
| 3 | Posterior dorsal head warts small, oval or round, widely separated; pronotal warts widely separated (Fig. 54) | GLOSSOSOMATIDAE |
| – | Posterior dorsal head warts large, almost meeting medianly; pronotal warts closely set (cf. Fig. 53) | PALAEAGAPETUS (p. 160) |

Larva (partly after Ross, 1944)

- | | | |
|---|--|------------------------|
| 1 | A pair of well-developed nota present on all three thoracic segments; larvae usually inhabiting purse-type cases of silk with particles of moss and liverwort attached | PTILOCOLEPINAE |
| – | Pronotum only sclerotized; larva without case or with small saddle-like case (flat ventrally, vaulted dorsally) covered in small stones or large sand grains | 2 |
| 2 | Anal prolegs with large elongate hooks; abdominal tracheal gills present or absent; free-living, without case | RHYACOPHILIDAE |
| – | Anal prolegs with very small retractile hooks; tracheal gills absent; with small saddle-like cases covered in small stones | GLOSSOSOMATIDAE |

Pupa

- | | | |
|---|--|-------------------------------|
| 1 | Presegmental and postsegmental dorsal hook plates on abdominal segments III–VII and III–V respectively (Fig. 52) | 2 |
| – | Presegmental and postsegmental hook plates not with full complement as above | 4 |
| 2 | Pupal mandibles without teeth | HYDROPTILINAE |
| – | Pupal mandibles with teeth (Ptilocolepinae) | 3 |
| 3 | Pupal mandibles with 2 teeth | PALAEAGAPETUS (p. 160) |
| – | Pupal mandibles with 1 tooth | PTILOCOLEPUS (p. 160) |
| 4 | Presegmental hook plates always absent from abdominal segment III (i.e. present on IV–VIII; post-: III–IV); spur formula 3.4.4 | RHYACOPHILIDAE |



Figs 55–59 ♂ genitalia, Ptilocolepinae. 55–57, *Ptilocolepus*, lateral view, (55) *Pt. granulatus* (Pictet); (56) *Pt. colchicus* Martynov; (57) *Pt. extensus* McLachlan. 58–59, *Palaeagapetus celsus* Ross, (58) lateral view; (59) ventral view. (vide Figs 15, 16).

- Presegmental hook plates sometimes absent from segment III; postsegmental hook plates always absent from segment III, sometimes also from segment V; spur formula 2.4.4

GLOSSOSOMATIDAE

Genus *PTILOCOLEPUS* Kolenati

Ptilocolepus Kolenati, 1848 : 102. Type-species: *Ptilocolepus turbidus* Kolenati, by monotypy.

DISTRIBUTION. Palaearctic.

Ptilocolepus contains four species which occur in the western Palaearctic region eastwards to the Urals, the Caucasus and Iran, the commonest and most widespread species being *granulatus*. The identity of *villosus* from Spain is questionable due to the inadequacy of the original description (Navás, 1916); the species may prove to be synonymous with either *granulatus* or *extensus* (N.B. *P. villosus* was not referred to by Schmid, 1949, in his paper on the Navás types).

The following key to the males of *colchicus*, *granulatus* and *extensus* is based on a study of material in the BMNH collections. Females of *granulatus* are in the BMNH collections but have not been described; the larva of this species has been described by Thienemann (1904) and Jacquemart & Coineau (1962).

DIAGNOSIS. *Adult*. Branches $R_2 + R_3$ and $M_1 + M_2$ fused in hindwing (Fig. 5), spur formula 1.3.4.

Larva. Abdomen without lateral tubercles, segment I with small dorsal tergite.

Pupa. Mandibles with two medial teeth.

Key to *Ptilocolepus* males (excluding *villosus*)

- 1 Hindwing with patch of modified setae; 'inferior appendages' (Fig. 56, *Ia*) bifurcate with dorsal process not longer than ventral, ventral process broad; 'ventral plate' with process (Fig. 56).
Caucasus and Iran *colchicus*
- Hindwing without patch of modified setae; 'inferior appendages' not as above; 'ventral plate' without process. 2
- 2 'Inferior appendages' (Fig. 55, *Ia*) bifurcate, dorsal process longer than narrow ventral process; 'ventral plate' without process (Fig. 55). Spain, Italy, Central Europe *granulatus*
- 'Inferior appendages' (Fig. 57, *Ia*) non-bifurcate; 'ventral plate' without process (Fig. 57).
Portugal, Spanish Pyrenees. *extensus*

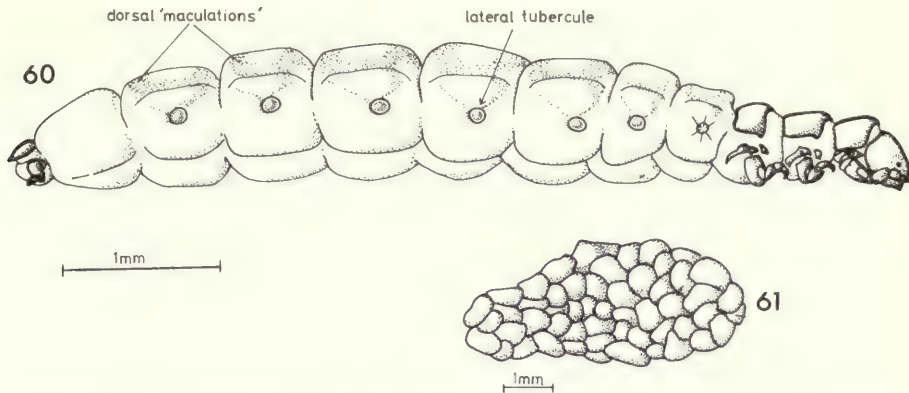
Genus *PALAEAGAPETUS* Ulmer

Palaeagapetus Ulmer, 1912a : 35. Type-species: *Palaeagapetus rotundatus* Ulmer, by monotypy.

DISTRIBUTION. Nearctic (and Baltic Amber).

Palaeagapetus is a small genus containing one fossil species (the type) and three extant Nearctic species. *P. rotundatus* is known only from Baltic Amber and is therefore probably of western European origin (and thus possibly Eocene according to Ross, 1956). The three North American species agree with the type form in features of venation, spur formula and male genitalia. *P. nearcticus* Banks and *guppyi* Schmid are western species, from California to Vancouver Island, while *celsus* Ross occurs in the east from the western Appalachians of North Carolina and Tennessee, New Hampshire to the Laurentians of Quebec (Roy & Harper, 1975). According to Wiggins (1977) it is likely that *celsus* will be found in montane areas between these two extremes.

There is no key to the species of *Palaeagapetus* and only the larva of *celsus* has been described (Flint, 1962).



Figs 60–61 *Palaeagapetus celsus* Ross. 60, larva, lateral view; 61, case, lateral view.

DIAGNOSIS. *Adult.* Branches R_2 , R_3 and M_1 , M_2 free in the hindwing (cf. Fig. 5); spur formula 2.4.4.

Larva. Abdomen with lateral pairs of segmental tubercles, segment I without tergite (Figs. 60, 61).

Pupa. Mandibles with one medial tooth.

Subfamily HYDROPTILINAE Stephens

Hydroptilidae Stephens, 1836 : 151. Type-genus: *Hydroptila* Dalman, 1819.

DISTRIBUTION. Cosmopolitan (excluding polar regions).

The Hydroptilinae is a very heterogeneous subfamily considered here to contain six distinct tribes characterized by fundamental adult, larval and pupal morphological features which unite them and distinguish them from the Ptilocolepinae.

DIAGNOSIS. *Adult* (Fig. 1). Forewing length 1.2–6.0 mm: wings narrow with rounded apices and almost complete venation in the larger, more generalized forms (Figs 6, 7) to highly attenuate with consequently reduced venation in the smaller, more specialized groups (Figs 8, 9, 10); Cu_1 unbranched in the forewing (Fig. 6, arrowed); wings densely pubescent, costal fringes usually long and well developed: sclerotization of head capsule reduced in the smaller forms; π -shaped tentorium basically well developed, anterior arms reduced medially to weakly sclerotized filaments (scarcely detectable in KOH-treated specimens) in smaller, specialized genera; ocelli 3, 2 or 0, lateral pair close to eyes and some distance posterior to antennae; antennae usually short, of approximately 30 segments (rarely 40, sometimes 18); postoccipital warts well developed, ovoid to subspherical, often represented by distinct sclerites hinged to the head capsule which, in *Hydroptila* males, conceal eversible scent-organs; compound eyes of variable size but usually occupying whole width of head capsule: thorax (e.g. Fig. 2) with close-set median pronotal warts; mesonotum flat, prescutum absent, scutellum with posterior half forming a triangular flat area with steep sides and a warty texture along edges only, anterior half triangular to arc-like, transverse suture present or absent; mesokatepisternal suture absent (Fig. 3, inset) (I have found this to be a constant feature of the Hydroptilinae, confirming Ross's (1956) view that it is 'usually' absent): fore-tibia with never more than one apical spur; meso-tibia with never more than one preapical spur (Fig. 4): abdomen with ventral processes variable (segments VI, VII or VIII); sternite V (Fig. 12) without postero-lateral ridge but with

a pair of small dorso-anterior pits usually containing a short, posteriorly directed setose membranous process: ♀ genitalia an oviscapt; segment IX usually long and telescopic (Fig. 17), rarely short and fixed with segment VIII modified (Figs 121, 134); ♂ genitalia variable but usually with a characteristic generic or tribe form (generalized form, Figs 15, 16); segment VIII usually with tergite and sternite distinct, rarely fused; segment IX forming an annular 'genital capsule', sometimes with various postero-lateral processes, antero-lateral apodemes and dorsal and ventral excisions, sometimes concealed by segment VIII; inferior appendages (*Ia*) usually present, size and shape variable, sometimes with baso-dorsal processes ('bracteoles'), sometimes fused and at times withdrawn into segment IX; tergite X reduced to dorsal plate (may be absent), size and degree of sclerotization variable; subgenital plate (process) or appendages (*Sp*) present; bilobed process (*Bp*) present ventral to subgenital plate, consisting of a membranous process with two short apical setae (sometimes appears to be fused to subgenital plate); aedeagus (*Ae*) variable but basically a long narrow sclerotized tube enclosing the phallosome which opens apically, a pair of lateral processes may occur along apical half (sometimes fused together or with central tube) which may be represented by a single spiral 'titillator' (homologies uncertain).

Larva. Early instars (I–IV) free-living (Fig. 51), fifth instar case-bearing (e.g. Figs 74, 75). All three thoracic segments with paired nota completely covering dorsa; abdomen distended, membranous, compressed laterally or dorso-ventrally, rarely cylindrical, abdominal gills absent. Ecdysial lines of head distinct (Figs 18–19), sometimes fused; ventral apotome and postmental sclerites variable (Figs 21–28), small posterior ventral apotome sometimes present (Fig. 27); labrum basically symmetrical; mandibles (Figs 30–32) primitively symmetrical and each with mesal brush (in left mandible only in specialized groups), cutting edges ridged or modified as sharp blades or 'scoops' (Figs 31–32); thoracic sternites variable (Figs 38–46) with a maximum of three per segment (one median 'oral' and two lateral 'anal'); pleurites primitively with preepisternite free on all segments, usually free on segment I only; anal epimeral pleurite sometimes present (Figs 35–37); legs variable, basically short and subequal, modified variously as robust, strongly clawed clinging organs (e.g. Fig. 89) or with mid- and hindlegs long and slender as in vegetation dwellers (e.g. Figs 123, 128, 132); abdominal tergites present or absent, tergite IX always present; dorsal 'rings' usually present on segments I/II–VIII; anal prolegs usually fused to sides of segment X (except in early instars and fifth instar of *Alisotrichia* and the *Neotrichiini*).

Case. Variable, basically purse-like of two silken valves with anterior and posterior slit-like openings (e.g. Fig. 119), sometimes with incorporated inorganic or organic particles; usually held horizontally. Sometimes, however, the case may be cylindrical or fusiform with slit-like (Fig. 138) or circular (Figs 103, 107) openings; in specialized torrenticolous or madicolous forms the case is greatly flattened dorso-ventrally and firmly fixed (temporarily or permanently) to the substrate (Figs 75, 78, 86) and may sometimes have lateral 'wings' (Figs 76, 81, 148).

Pupa. Of the typical hydroptilid form (Fig. 52); presegmental and postsegmental plates on abdominal dorsa III–VII and III–V respectively; mandibles without teeth, usually long. Case formed by sealing the larval case which has been previously attached to the substrate by adhesive discs at the corners or by one seam.

BIOLOGY. The subfamily contains both cool- and warm-adapted genera which occur in a wide variety of habitats; it is almost cosmopolitan in distribution, being absent only from the extreme polar regions. Habitat preferences range from seeps, springs and splash zones of waterfalls to clear, fast-flowing montane streams, and from all sizes of rivers to still (but rarely stagnant) ponds in lowland regions.

The larvae are basically detritus-feeders but some groups have adopted special methods for feeding on the fluid contents of the cells of filamentous green algae, the most specialized genus in this respect being *Orthotrichia*. The distribution and life-histories of the algal-feeding groups are dependent on those of the algae, and genera vary as to whether they occur with the algae on the substrate or amongst vegetation. The primitive Nearctic genus *Dibusa* is unique in that it is associated with the red fresh-water alga, *Lemanea* (Wiggins, 1977).

Key to tribes (for keys to genera see p. 153)

Adult

- | | | |
|---|--|-------------------------------|
| 1 | Transverse suture present on mesoscutellum (Figs 62, 83, 93) | 2 |
| – | Transverse suture absent from mesoscutellum (e.g. Figs 108, 114, 120) | 3 |
| 2 | Metascutellum subpentagonal to triangular (Figs 83, 93) (Nearctic, Neotropical) | |
| | | LEUCOTRICHINI (p. 175) |
| – | Metascutellum subrectangular to short pentagonal (Palaeartic) or as wide as scutum, very short and rectanguloid (Figs 62–64) (Holarctic, Palaeotropical) | |
| | | STACTOBIINI (p. 163) |

- 3 ♂ aedeagus thread-like or armed with thickened spines, spiral 'titillator' absent (Figs 94, 96) (Nearctic) **OCHROTRICHIINI** (p. 184)
- ♂ aedeagus usually divided into proximal and distal sections, spiral 'titillator' usually present (Figs 15, 101, 109, 122, 135, 140) 4
- 4 ♂ genitalia asymmetrical (Fig. 135) or with segments IX and X membranous dorsally, IX incomplete ventrally with lateral sides tapering posteriorly, inferior appendages slender (Fig. 140) (cosmopolitan) **ORTHOTRICHIINI** (p. 212)
- ♂ genitalia symmetrical, not as above 5
- 5 Adults small, forewing length 1.5–2.0 mm; segment IX or inferior appendages of ♂ genitalia with a pair of broad, flat, spatulate processes or lobes (bracteoles) (Fig. 101) (Nearctic, Neotropical) **NEOTRICHIINI** (p. 188)
- Adults small to large, forewing length 1.5–6.0 mm; ♂ genitalia very variable, usually without broad bracteoles (Figs 109, 115–117, 122, 127, 129, 131) (cosmopolitan) **HYDROPTILINI** (p. 191)

Tribe **STACTOBIINI** Botosaneanu **stat. n.**

Stactobiinae Botosaneanu, 1956 : 382. Type-genus: *Stactobia* McLachlan, 1880.

DISTRIBUTION. Holarctic.

Botosaneanu (1956) erected the subfamily Stactobiinae for *Stactobia* and 'les genres étroitement apparentes' (*Stactobiella*, etc.). Although Botosaneanu did not name these genera, he probably intended the group to include *Stactobiella*, *Plethus*, *Plethotrichia* and *Lamonganotrichia* as suggested by the knowledge of the group at that time. Ulmer (1957) considered *Plethus* and *Lamonganotrichia* to be closely related according to their larval affinities; on adult features alone, however, *Plethus* bears more resemblance to *Plethotrichia* while *Lamonganotrichia* is more like *Orthotrichia*. Ulmer also considered the larva of *Plethotrichia* to have more affinity with that of *Hydroptila* and consequently placed it in the Hydroptilinae sensu Nielsen (1948) (*vide* Table 1).

Schmid (1959a), despite recognizing Botosaneanu's subfamily grouping, remarked on the relationships of *Stactobia* with *Stactobiella*, *Chrysotrichia*, *Madioxyethira*, *Pseudoxyethira*, *Parastactobia*, *Macrostactobia* and *Plethus* (the last of which Schmid considered *Plethotrichia* to be a possible synonym). Flint (1970), on the basis of larval morphology and case form, considered *Plethus* and *Lamonganotrichia* to belong in the Stactobiinae but placed *Stactobiella* in the Hydroptilinae sensu Nielsen (1948) along with *Hydroptila*, *Agraylea* and *Oxyethira*.

Morse (1974) has independently remarked on the relationship of *Catoxyethira veruta* Morse, from S. Rhodesia, with the Holarctic genus *Stactobiella* according to features of the adults; Ulmer (1957) had previously noticed the relationship of the larvae of *Catoxyethira* and *Stactobia*.

Examination of adult type-material has revealed errors in the original diagnoses of the genera which are henceforth considered to comprise the tribe Stactobiini; such anomalies have occurred in the interpretation of spur formulae, presence of ocelli and wing venation features, all of which were once considered to be very important in deducing generic relationships. The present grouping is thus based on more reliable features such as the male and female genitalia, head and thoracic structures and amended ocellar counts and spur formulae; a number of previously unsuspected relationships and possible synonymies have also been discovered.

Since the constituent genera exhibit a number of larval and adult features which are unique to the stactobiines the group is treated as a distinct tribe although three main genus-groups may be recognized. These are the *Stactobia*-group (*Stactobia* and *Plethus*), the *Stactobiella*-group (*Stactobiella*, *Bredinia*, *Parastactobia* and *Chrysotrichia*) and the *Madioxyethira*-group (*Madioxyethira*, *Pseudoxyethira* and *Scelotrichia*). Within the tribe the genera show various lines of development and specialization in either the larval or the adult stages or both, but they all share the basic common features (set out below) from which the principal characters of a hypothetical stactobiine ancestor may be deduced. As more becomes known of the group, especially of the larval stages, the following tentative conclusions may accordingly require modification.

DIAGNOSIS. *Adult* (Figs 62–64). Head with tentorium complete; antennae short, usually 18-segmented; ocelli 3: mesoscutellum with transverse suture; metascutellum with anterior edge approximately straight, parallel with posterior edge; abdominal segment V with typical short, lateral setose processes: ♀ genitalia

an oviscapt: ♂ genitalia (Figs 65–68) with tergite and sternite VIII distinct; IX reduced ventrally, sternite vestigial (absent or fused with tergite ?); inferior appendages small, distinct; paired subgenital structures ('subgenital appendages', Schmid, 1959a) heavily sclerotized, arched downwards, sometimes represented by a fused sclerite (?); bilobed process absent; tergite X absent or reduced; aedeagus (Figs 69–73) long, straight, without median constriction or spiral titillator, basically tripartite with a single apical process arising midlength beneath (or above) which are two flattened processes fused along most of their length (often only the apex reflects this form as a dilated, trilobed structure), sometimes rows of short apical setae or heavily sclerotized subapical spines may be present.

Larva. The larval stages are only known for *Stactobia*, *Plethus*, *Stactobiella* and *Catoxyethira* (including also *Lamonganotrichia* and *Plethotrichia*). The genera have different structural adaptations associated with their various habits and ecological preferences and do not appear superficially to be as homogeneous as the adults. The generalized larval form, as seen in *Stactobiella*, is that of the typical hydroptilid with the fifth instars inhabiting transportable purse-type cases. However, the main evolutionary trend within the group has been the adaptation to life in fast-running water and the thin surface film of water on rocks (the madicolous, hygropetric or hydropetric habitat). Various degrees of specialization occur but the basic trends are towards the dorso-ventral flattening of the body and case, the attachment of the case to the substrate, the protection of the body by fusion and thickening of dorsal sclerites and the development of the thoracic legs as strong clinging appendages. The most advanced genus in this respect is *Stactobia*, which is truly madicolous, while *Plethus*, according to Schmid (1958a), although morphologically similar to *Stactobia* does not share its 'hydropetric' habits. Schmid (1960) also states that *Madioxyethira milinda* is exclusively madicolous, but this is purely speculative since the larva of this species is unknown.

Pupa. Typically hydroptilid with no distinguishing characters; mandibles long, without teeth.

DISCUSSION. On the basis of adult and, to a lesser extent, larval affinities the genera of the Stactobiini as defined here appear to fall into three natural groups. Each group contains both generalized and highly specialized representatives of which the former exhibit the basic features by which the relationships of the three groups may be recognized.

The *Stactobia*-group is distinguished by the shape of the metascutellum and the general form of the larvae. *Plethus* would appear to be the most typical and generalized representative on account of the unmodified male genitalia, which are highly specialized in *Stactobia*, and the larvae which, although obviously adapted for life in running water, are not, according to Schmid (1958a), as hygropetric in their habits as are those of *Stactobia*. *Plethus* is restricted to the SE. Asian region while *Stactobia* appears to be a more successful group with a continuous recent temperate distribution in the Old World and a few subtropical representatives. The *Stactobia*-group appears to fill the Old World niche occupied by the Leucotrichiini in the New World. *Lamonganotrichia* is grouped with *Stactobia* and *Plethus* on the basis of larval affinities whereas *Plethotrichia*, although almost identical with *Plethus* in male genitalic features, most closely resembles *Stactobiella* in larval features; the latter may simply be due, however, to the retention of the generalized hydroptilid form in both these genera.

The *Stactobiella*-group is characterized by the distinctive narrow, strip-like form of the metascutellum of the adults. *Stactobiella*, *Bredinia* and *Chrysotrichia* have generalized male genitalia very similar to those of *Plethus*; *Catoxyethira* and *Parastactobia*, however, both have very unusual, specialized genitalia. The group as a whole has a wide distribution with Palaearctic, Nearctic, Oriental and African representatives. Only the larval stages of two genera are known, *Stactobiella* from a single Nearctic species (which has the unmodified hydroptilid form) and *Catoxyethira* from essentially an unidentified African species which, according to Ulmer (1912b; 1957), resembles that of *Stactobia*. It may thus be that the larvae of *Stactobiella* (and *Plethotrichia*) have retained the basic hydroptilid form while those of *Stactobia* (including *Lamonganotrichia*), *Plethus* and *Catoxyethira* have become adapted and structurally modified for life in fast-running water conditions.

Madioxyethira, *Pseudoxyethira* and *Scelotrichia* are African and SE. Asian genera grouped here according to the shape of the mesoscutellum, the reduced apical process of the fore-tibia, the shape of the post-occipital lobes and the unique forms of the male genitalia (and possibly also the genital-duct loop of the female). The larvae of these genera are completely unknown but they are included in the Stactobiini on the basis of the form of the thorax and the short antennae, and because the male genitalia may be derived from the basic stactobiine form.

It would thus appear that the Stactobiini is essentially an early offshoot of the main Hydroptilinae branch with representatives which have become isolated in the now equatorial regions of Africa and SE. Asia. *Stactobiella* is distinct in that it has a more northerly Holarctic distribution with local species in montane habitats extending from Central Europe to the eastern United States. The most successful and best represented genus is *Stactobia*. This may be due to its specialized larval habits which allow it to fill a unique niche with no competition from any other Palaearctic hydroptilid. *Stactobia* also has a continuous Palaearctic distribution.

The Stactobiini may have arisen from originally 'cool-adapted' montane stream-dwelling ancestors which gave rise to two main lines, the first (1) becoming 'cool-temperate-adapted' while the second (2) became more 'warm-adapted'. Line 1 is the *Stactobiella*-group containing the 'cool-adapted' genus *Stactobiella* which has retained a northerly distribution. It appears to have crossed via the Bering route down into the North American mountain chains of the western 'Rockies' and eastern Laurentians and Appalachians, where isolated populations are still maintained. A more 'temperate-adapted' line leading to the African and SE. Asian genera *Chrysotrichia*, *Catoxyethira* and *Parastactobia* may also have arisen from line 1. The North American *Stactobiella* line may have given rise to (if *Stactobiella* is not synonymous with) the Central American genus *Bredinia*.

Line 2, consisting of the *Stactobia*- and *Madioxyethira*-groups, became more 'warm-adapted' and probably had a past continuous distribution extending from Africa through North Africa, SW. Asia to SE. Asia at a time when these areas were linked by one great forest. When the climate became drier and severed the links between these two continents, representatives of these once widespread genera became isolated in the Oriental and African regions where the original conditions were, and still are, maintained. In the latter continent these areas occur in the forests surviving in western Africa, the mountain slopes of eastern Africa and along the rivers through to southern Africa which are precisely the regions from which these hydroptilids have been recorded, namely Nigeria and Zaire (compare also the distribution of *Ugandatrichia*). The most recent successful representative of line 2, *Stactobia*, now has a continuous subtropical Palaearctic distribution in the mountain ranges extending from eastern Asia (Japan) through Asia Minor, the Mediterranean region and North Africa out to the Atlantic Islands. Some species of the *furcata*-group have spread northwards into the more temperate Central European regions while representatives of the *vaillanti*-group have been discovered in Africa (Guinea and Uganda).

In conclusion, the Stactobiini appears to have arisen from an ancestor which evolved early in the history of the Hydroptilinae. The tribe is quite distinct from any other belonging to this subfamily and its possible relationships with the New World tribe Leucotrichiini will be discussed later.

Genus *STACTOBIA* McLachlan

Stactobia McLachlan, 1880 : 505. Type-species: *Hydroptila fuscicornis* Schneider, by subsequent designation by Mosely (1933).

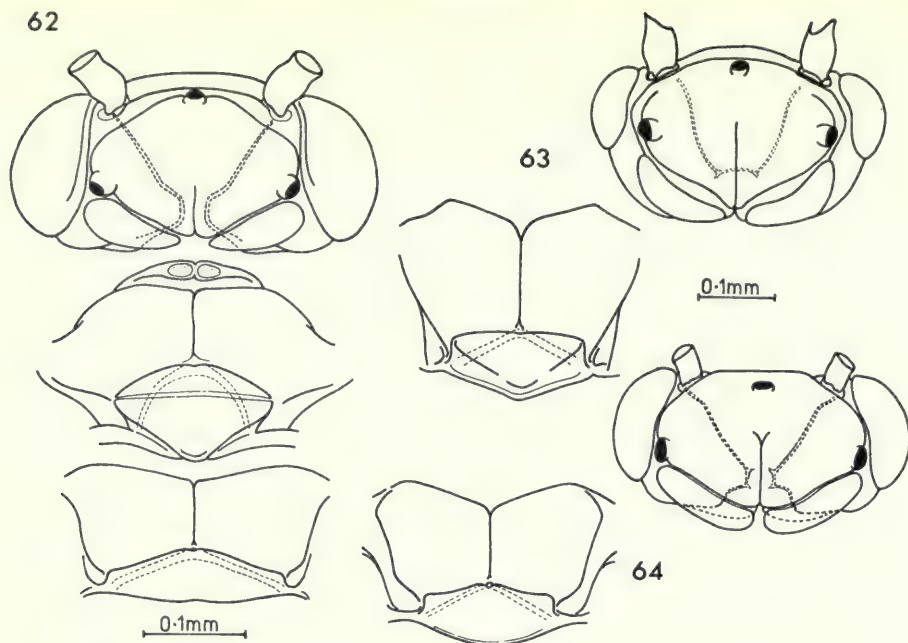
Afrित्रichia Mosely, 1939b : 35. Type-species: *Afrित्रichia aurea* Mosely, by original designation and monotypy. [Synonymized by Schmid, 1959a.]

Aratrichia Mosely, 1948 : 76. Type-species: *Aratrichia fahjia* Mosely, by original designation and monotypy. [Synonymized by Schmid, 1959a.]

Lamonganotrichia Ulmer, 1951 : 68. Type-species: *Lamonganotrichia crassa* Ulmer, by original designation and monotypy. **Syn. n.**

DISTRIBUTION. Palaearctic, SE. Asia, Africa.

McLachlan erected this genus for *fuscicornis* and a new species, *eatoniella*, the true identities of which were subject to a careful investigation by Kimmins (1949). Larvae of the type-species were collected by Zeller from Messina (Sicily) along with the adults on which Schneider based his original description. Eaton (1873) referred to the biology of the larvae remarking that they '... at first roam at large, caseless; when they become corpulent they construct oval cylindrical cases of fine mud. They abound on rocks suffused with an extremely thin film of water resulting from the spray and dribbling of trickling streamlets, especially in places exposed to the sun!'; he was thus



Figs 62–64 Adult head and thorax, Stactobiini. 62, *Catoxyethira* sp.; 63, *Stactobia* sp.; 64, *Madioxyethira* sp.

the first to record both larval hypermetamorphosis in the Hydroptilidae and the madicolous habits of *Stactobia*.

Prior to Schmid's (1959a) paper on *Stactobia* the major contributions, albeit fragmentary, to the knowledge of the genus were by Mosely (1933), Vaillant (1951a; 1951b; 1952; 1956) and Botosaneanu (1956). Schmid subdivided the genus, which contains approximately 45 species, into four main species-groups, of which a summary of the main features is given below (partly adapted from Jacquemart, 1973). In the checklist the species are arranged according to these groups with new species (i.e. post Schmid, 1959a) being assigned correspondingly. Examination of the type of *Lamonganotrichia crassa* reveals that the genus *Lamonganotrichia* is synonymous with *Stactobia* according to structural affinities of the adult head, thorax and genitalia and similarities in the larva as described by Ulmer (1957).

DIAGNOSIS. Adult. Forewing length 1.5–4.0 mm; compound eyes relatively small; postoccipital lobes wide, suboval (Fig. 63); mesoscutellum narrow, deep (Fig. 63); spur formula 1.2.4 (Fig. 4) (0.2.4 in *radavanovici* Schmid); fore-coxae notched and fringed (Fig. 4); ♂ genitalia (Fig. 66) specialized; sternite VIII displaced posteriorly; segment IX reduced ventrally, often produced anteriorly as a pair of lateral apodemes; inferior appendages small, rarely elongate; subgenital appendages strongly sclerotized, arched; tergite X semimembranous; aedeagus long, straight, often considerably developed but sometimes thin and simple, usually with a dilated, heavily spined, membranous apex; ventral process of VII long, sinuous and thickened apically.

Larva. Early instars free-living, caseless, dorso-ventrally flattened and with tergites present on all abdominal segments. Fifth instars (Fig. 74) case-bearing, dorso-ventrally flattened; sclerotization well developed; setae modified as short, stout, protective spines. Sclerites of head fused; labrum symmetrical; mandibles (Fig. 30) not markedly asymmetrical, massive, heavily ridged, 'shovel-like', brushes present in both left and right (Botosaneanu, 1956); anterior ventral sclerites paired (Fig. 25); thoracic nota paired, medial lines distinct; preepisternite free on all three segments; sternites as in Fig. 38; legs short, subequal, robust, adapted for clinging; tergites present on all abdominal dorsa; posterior margin of tergite IX with 'crenellations' (modified flattened setae ?).

Case (Fig. 75). Dorso-ventrally compressed; transportable but usually temporarily fixed to substrate; barrel-shaped with dorsal and ventral longitudinal seams and slit-like anterior and posterior openings;

constructed of silk and fine grains of mud or sand. The case of *Lamonganotrichia* (Fig. 76, after Ulmer, 1957) is suboval or shield-shaped, with a central rectangular section occupied by the larva, and is bordered by a wide lateral folded fringe; a ventral longitudinal seam appears to be present.

BIOLOGY. The greatest contribution to the knowledge of the biology of *Stactobia* was made by Vaillant (1956) while detailed life-history data are given by Danecker (1961). The larvae are unique within the Hydroptilidae because they are madicolous (hygropetric, hydropetric), that is they are adapted to live in the tenuous habitat formed, according to Hynes (1970), by 'thin sheets of water flowing over rock faces' which 'although it is hardly a running-water habitat in the ordinary sense, it is often situated very close to one'. Thus the habitat often occurs at the edge of streams by the side of waterfalls and on rocky chutes, the faces of which may be almost vertical. Such conditions require very special structural adaptations of the inhabitants which can be clearly seen in the larvae and cases of *Stactobia* (Figs 74, 75). Both are dorso-ventrally flattened and capable of maintaining a thin film of water over their dorsal surfaces by surface tension; the cases are temporarily fixed but may be moved if conditions become unfavourable; the larvae are protected dorsally by heavily sclerotized fused tergites and spine-like setae and their short, robust legs are used for clinging to the substrate. The larval mouthparts are adapted for feeding on organic particles ('phytosaprophagous' according to Vaillant, 1956), the mandibles (Fig. 30) being robust, strongly ridged and having a scraping function. According to Vaillant (1956) the larvae are exclusively petrimadicolous, that is they occur only on rocky substrates almost devoid of sediment and filamentous algae. The pupae are often gregarious forming a 'Puppeneste' (Danecker, 1961) in which the cases are closely packed in a single 'colony'.

SPECIES-GROUPS (after Schmid, 1959a and Jacquemart, 1973). The *furcata*-group (20 species): this is the largest and most homogeneous group, its main feature being the constancy of the form of the male subgenital appendages; its distribution extends throughout central and southern Europe, the Atlantic Islands, North Africa, Israel and Turkey.

The *martynovi*-group (13 species); this is less homogeneous than the previous group and is characterized by the dorsal thickenings of tergite X and the anterior displacement of the inferior appendages of the males (most marked in *ulmeriana* Schmid to which, in my opinion, *schmidii* Kimmins from Nepal is most closely related); the group is restricted to southern Asia – Iran, Pakistan, Sri Lanka, Burma, Nepal and Turkestan (U.S.S.R.).

The *nielseni*-group (seven species including *Lamonganotrichia crassa*): this group is distinguished by the modified sternite VIII and the absence of any subgenital appendages in the males; representatives occur in Southern Yemen (Aden), Iran, Pakistan and Indonesia (Java).

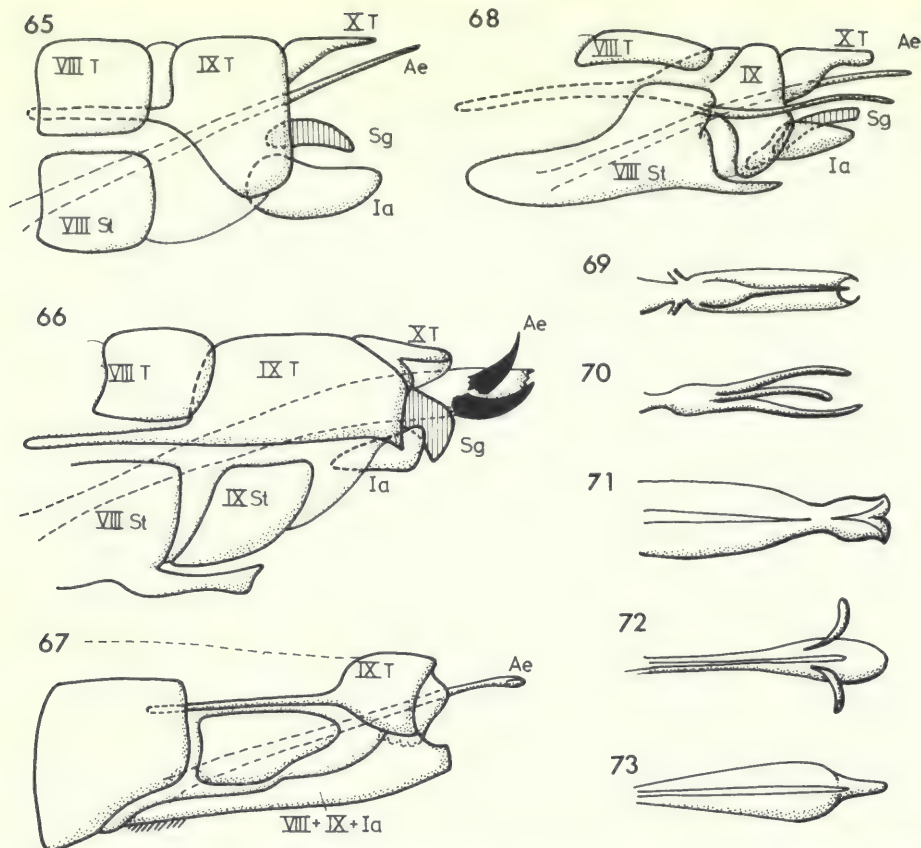
The *vaillanti*-group (two species): exclusively an African group with *vaillanti* Schmid from Guinea and *aurea* (Mosely) from Uganda.

S. bolzei Jacquemart (Turkey) is considered by Jacquemart (1965) to be distinct although I believe that it may belong to the *nielseni*-group (original description inadequate for direct comparison).

S. japonica Iwata (Japan) is known only from the larva of which the case bears more resemblance to that of *Plethus* as figured by Ulmer (1957); the *japonica* of Tsuda & Nakagawa (1959) may be a distinct species since again only the larvae were examined.

S. megalatlantica Vaillant and *mallorcensis* Vaillant are nomina nuda.

DISCUSSION. *Stactobia* is a very specialized member of the Stactobiini. Although it is one of the more successful hydroptilid genera in terms of both species and individual numbers it does not have the widespread geographical ranges of, for example, *Hydroptila*, *Oxyethira* or *Orthotrichia*. The madicolous habits of the larvae perhaps enable *Stactobia* to occupy a niche where it is free from competition from these other genera, at least in the Palaearctic and parts of the Palaetropical regions. The absence of *Stactobia* from the New World may be due to two factors: (i) the slow rate of dispersal of montane stream-dwelling forms in comparison with lowland vegetation dwellers where geographic barriers are less pronounced (see later discussions) and (ii) competition with the highly successful New World Leucotrichiini which exhibit parallel modifications suiting them to a similar mode of life.



Figs 65–73 Generalized ♂ genitalia, Stactobiini. 65–68, lateral view, (65) *Stactobiella*, *Plethus*, *Chrysotrichia*; (66) *Stactobia* (after Schmid, 1959a); (67) *Madioxyethira*; (68) *Catoxyethira*. 69–73, aedeagus, dorso-ventral views, (69) *Stactobiella*; (70) *Chrysotrichia*; (71) *Madioxyethira*; (72) *Pseudoxyethira*; (73) *Catoxyethira*. (vide Figs 15, 16.)

Stactobia could have arisen from temperate or subtropical Palaearctic stock which penetrated southwards into Africa and SE. Asia and northwards into central Europe. It is totally absent from the northern Palaearctic region, there being no Scandinavian or British representatives of the genus.

Genus *PLETHUS* Hagen

Plethus Hagen, 1887 : 643. Type-species: *Hydroptila cursitans* Hagen, by monotypy.

Plethotrichia Ulmer, 1951 : 65. Type species: *Plethotrichia baliana* Ulmer, by original designation and monotypy. **Syn. n.**

DISTRIBUTION. S. and SE. Asia.

Plethus was erected for the type-species from Sri Lanka and now contains another five species from this island (Schmid, 1958a), one from Pakistan (Schmid, 1960) and three from Indonesia (Ulmer, 1951); the larvae of *acutus* and *cruciatu*s were described by Ulmer (1957). *Plethotrichia baliana* was originally considered to be closely allied to *Plethus* but was separated on account of the unmodified larval case (Ulmer, 1957); a close examination of the adult features, however, indicates that the two genera are synonymous. *Stactobia japonica* Iwata from Japan also resembles *Plethus* in the form of the larval case.

DIAGNOSIS. Adult. Forewing length 1–2 mm: head and thorax similar to those of *Stactobia* (cf. Fig. 63): spur formula 0.2.3; wing venation greatly reduced; veins of forewing confluent before margin; veins of

hindwing reduced to the two main longitudinal subparallel stems of *R* and *M*; costal fringes well developed: ♂ genitalia (Fig. 65) simple, generalized without ventral processes; VIII unmodified; IX reduced ventrally although the sternite may be vestigial in some species, anterior apodemes short; inferior appendages unmodified; subgenital appendages heavily sclerotized, arched; tergite X variable; aedeagus long and straight without apical spines, sometimes with a pair of short basal processes: the anterior abdominal segments of the male may bear sensorial organs (Schmid, 1958a) which, in *baliana*, occur on tergites V and VI according to Ulmer (1951).

Larva (Fig. 77). Dorso-ventrally compressed; small abdominal tergites present, posterior margin of tergite IX simple; legs short, robust, subequal, unmodified; thoracic sternites as in Fig. 43.

Case (Fig. 78). Dorso-ventrally compressed, barrel-shaped with dorsal and ventral seams and a lateral fringe ('wings').

According to Ulmer (1957) the larvae of *Plethotrichia* are more like those of *Oeceotrichia* (here synonymized with *Hydroptila*) in that they are not dorso-ventrally compressed, there are no abdominal tergites and the fore-tibia bears a short process. The case is of the purse-type, flattened laterally and constructed of secretion and diatoms. However, the larvae were not reared and no pupae were collected to confirm the association of larvae and adults.

BIOLOGY. The larvae inhabit brooks amongst 'spongy algal masses' of *Cladophora* and 'silicaceous' algae (Ulmer, 1957). According to Schmid (1958a) the adults are abundant by streams, fast-flowing rivers and rocky streams and are not attracted to light. The larvae are not hygropetric although Schmid (1958a) suspects that they live amongst the rocks in shallow water. According to Ulmer (1957) the larvae of *Plethotrichia* live in flowing water, springs (including warm springs), waterfalls and brooks, often in moss and algae.

DISCUSSION. The adults of *Plethus* retain many primitive features of the generalized stactobiine hydroptilid, their main specializations being their reduced size and wing venation and the presence of specialized male abdominal sensorial organs. The larvae, although adapted to live in fast-flowing shallow water, are not as specialized as the petrimadicolous larvae of *Stactobia*. *Plethus* is essentially a warm-adapted genus confined to the Oriental region.

Plethus is most closely related to *Stactobia* and was probably an early offshoot of the *Stactobia*-group branch of the Stactobiini and which has retained certain primitive attributes. Its main diagnostic features are the adult spur formula, overall reduced size and less specialized genitalia, larva and case (i.e. with respect to *Stactobia*).

Genus *STACTOBIELLA* Martynov

Stactobiella Martynov, 1924 : 57. Type-species: *Stactobia ulmeri* Siltala, by monotypy.

Tascobia Ross, 1944 : 124. Type-species: *Stactobia palmata* Ross, by original designation. [Synonymized by Ross, 1948.]

DISTRIBUTION. Holarctic.

Stactobiella is a small Holarctic genus containing six species, three of which are Palaearctic (northern and eastern Europe, Siberia) and three Nearctic which, according to Wiggins (1977), have been recorded over much of the North American continent west to the Rocky Mountain states and north to Minnesota, Ontario and Maine. *S. risi* from Switzerland was first described in *Microptila* but was transferred to *Stactobiella* by Ulmer (1929); Döhler (1963) synonymized *risi* with *ulmeri* but the species were later considered to be distinct by Botosaneanu (1967) and are regarded as such here. Ross (1944) gives diagnostic characters for the males and females of *delira* and *palmata* and (Ross, 1948) a key to the males of all six species.

The species are grouped below according to features of the male genitalia (after Ross, 1948).

The *biramosa*-group: *biramosa* (Siberia, 'Russia'); *palmata* (Oklahoma, Wisconsin, Illinois, Kentucky, Maine, Tennessee, Oregon).

The *ulmeri*-group: *ulmeri* (Finland, Germany, Poland, Rumania, U.S.S.R.); *risi* (Switzerland); *delira* (Wyoming, Colorado, Minnesota, Wisconsin, Maine, Kentucky, New Hampshire).

The *brustia*-group: *brustia* (Wyoming).

DIAGNOSIS. *Adult.* Forewing length 1.5–3.0 mm: metascutellum narrow, as wide as metascutum (cf. Fig. 62); spur formula 1.3.4: ♂ genitalia (Fig. 65) with segment VIII unmodified; IX well developed, especially dorsally, with long anterior apodemes; inferior appendages fused in *brustia*, sometimes with basodorsal bracteoles; subgenital plate strongly sclerotized, arched; tergite X absent or membranous; aedeagus (Fig. 69) simple, tubular, with fused lateral processes and a free median process in *delira*.

Larva (after Ross, 1944 and Wiggins, 1977). Body slightly compressed laterally: abdomen without tergites (except on segment IX); dorsal abdominal 'rings' present (II–VIII); legs short, subequal, stout; tarsal claws distinct, sharply curved and with thickened basal spur nearly half as long as claw (Fig. 80); setae unmodified: preepisternite free on all thoracic segments, episternite and epimeron fused in meso- and metathorax.

Case (Fig. 79). Purse-type, laterally compressed, constructed of silk only.

BIOLOGY. The larvae of *palmata* are found in small, fairly swift streams on stones in riffles and they mature in the early spring in Illinois (Ross, 1948). According to Wiggins (1977) it is therefore likely that this species overwinters as final instar larvae.

DISCUSSION. Adult features indicate that *Stactobiella* is related to *Stactobia* and *Plethus* although the metascutellum shows a close resemblance to those of *Chrysotrichia*, *Parastactobia* and *Catoxyethira*. The larvae are unspecialized and exhibit the basic hydroptilid form, the case being of the purse-type and laterally compressed. The genus thus appears to be an early offshoot of the Stactobiini which has retained many primitive larval and adult features. It is a temperate group which may have originated in the Palaearctic region and has had at least two subsequent migrations into the Nearctic region (via the Bering route) as indicated by the relationships of *delira* with *ulmeri* and *risi*, and of *palmata* with *biramosa*. The affinities with the other genera of the *Stactobiella*-group will be discussed later.

Genus **BREDINIA** Flint

Bredinia Flint, 1968c : 50. Type-species: *Bredinia dominicensis* Flint, by original designation and monotypy.

DISTRIBUTION. Lesser Antilles (Dominica).

The following diagnosis is adapted from the original description, the genus being known only from the type-series collected on Dominica in 1965. The larval stages are unknown.

DIAGNOSIS. *Adult.* Forewing length 1.5 mm: ocelli 3: mesoscutellum with transverse suture; metascutellum as wide as scutum, short and rectangular: spur formula 0.2.4: ♂ genitalia with sternite VIII divided mid-ventrally; IX narrow, oblique, lateral halves divided ventrally by the inferior appendages and with long anterior apodemes; tergite X a large membranous lobe; inferior appendages small, quadrate; subgenital plate elongate, rectangular; aedeagus tubular, apex flat and tridentate, central tubule in apical quarter.

BIOLOGY. The adults were taken only near the larger lowland rivers of the island.

DISCUSSION. Flint was uncertain of the relationships of this genus and simply listed its affinities with *Neotrichia* (presence of ocelli, minute size and spur formula), with *Mayatrichia* (spur formula) and with *Alisotrichia* (transverse suture of the mesoscutellum and lateral apodemes of segment IX in the male genitalia). Although Flint noted the similarity of the thoracic nota of *Bredinia* to those of *Stactobiella*, he did not consider these genera to be closely related. According to Flint's (1968c; 1970) descriptions, *Bredinia* bears more resemblance to *Stactobiella* than to *Alisotrichia*, especially with respect to the thoracic nota (cf. Figs 62, 83), the lateral apodemes of the male segment IX and the tridentate aedeagus (Figs 65, 69–73, cf. Fig. 84). The main distinction between *Bredinia* and *Stactobiella* is their spur formulae (0.2.4 and 1.2.4 respectively). As Flint notes, however, the affinities of *Bredinia* may be clarified when the larval stages have been discovered.

Genus **CHRYSTOTRICHIA** Schmid

Chrysotrichia Schmid, 1958a : 54. Type-species: *Chrysotrichia hatnagola* Schmid, by original designation.

DISTRIBUTION. S. and SE. Asia (Sri Lanka, India and Sarawak).

Five species described from Sri Lanka (Schmid, 1958a) and India (Schmid, 1960) comprise this small SE. Asian genus. The immature stages are unknown but the adults appear to be closely

allied to those of *Stactobiella* according to features of the head, thorax and male genitalia. *Chrysotrichia* may be distinguished by its distinctive spur formula and reduced size and wing venation. Examination of more material, especially of the larval stages, will be needed before any definite conclusions regarding relationships can be reached. The following generic diagnosis is based on original descriptions and examination of paratype material in the BMNH collections.

Series of what may prove to be one or more new species of *Chrysotrichia* have recently been collected from Sarawak, 1977 (*B. Bolton*); 1978 (*J. E. Marshall*). The specimens are in the BMNH.

DIAGNOSIS. *Adult.* Forewing length 1.25–1.50 mm: head and thorax as in *Stactobiella* (Fig. 62): ocelli 3 (N.B. absent according to Schmid, 1958a): wings essentially reduced to thin 'ribbon-like' strips; venation represented by only two main longitudinal veins in the hindwings, veins of forewings reduced but not concurrent at the margin as in *Plethus*; costal fringes very long: spur formula 0.2.4: ♂ genitalia generalized as in *Stactobiella* and *Plethus* (Fig. 65); segment VIII simple; IX reduced ventrally, anterior apodemes present; inferior appendages small; subgenital plate strongly sclerotized, arched; tergite X membranous; aedeagus (Fig. 70) long, simple, with a trilobate apex and sometimes with minute apical spines (as in *hatnagola*).

BIOLOGY. According to Schmid (1958a) the adults occur along calm rivers at moderate altitudes. *C. badhami* from the Punjab was taken by a fairly large river rich in aquatic vegetation (Schmid, 1960).

DISCUSSION. Schmid (1958a) states that the male genitalia greatly resemble those of *Plethus* from which they may be distinguished by the small size and weak sclerotization of the two terminal segments in comparison with the remaining abdominal segments. The male genitalia are also similar to those of the *ulmeri*-group of *Stactobiella*; the diagnostic features at present used to distinguish this genus from *Chrysotrichia* (spur formula, wing size and venation) may not be as critical as originally thought and the genera may prove to be synonymous.

Genus *CATOXYETHIRA* Ulmer

Catoxyethira Ulmer, 1912b : 82. Type-species: *Catoxyethira fasciata* Ulmer, by monotypy.

Sperotrichia Marlier, 1978 : 294. Type-species: *Sperotrichia mali* Marlier, by original designation and monotypy. **Syn. n.**

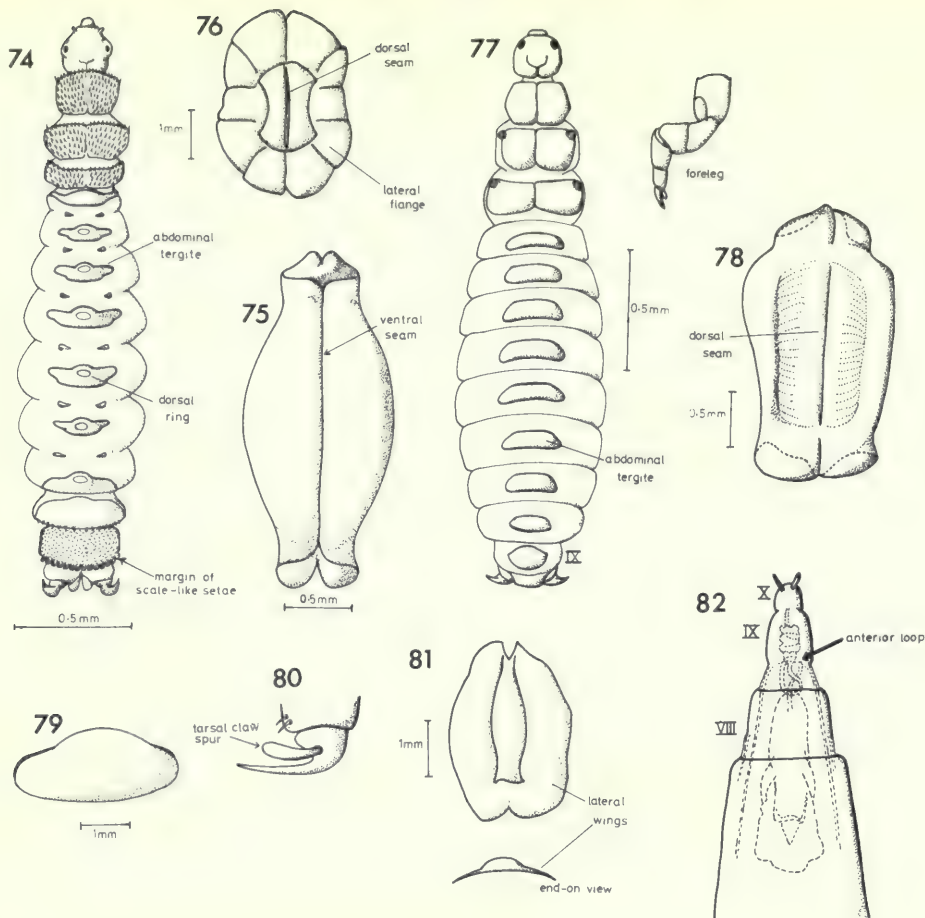
DISTRIBUTION. Africa.

Catoxyethira was erected for *fasciata* from Zaire by Ulmer (1912b) who described and figured the male genitalia. Ulmer (1912b) also outlined the main features of the larva and case of an unidentified species which he placed in *Catoxyethira* of which the generic identity is questionable since no positively determined adults were associated with it. *C. pinheyi* and *veruta* have since been described from the Victoria Falls and Rhodesia respectively and two new species, *ocellata* and *improcera* have been described by Statzner (1977) from Zaire; undetermined material collected by Prof. J. Medler from Nigeria is in the BMNH collection. Examination of the holotype and paratype of *Sperotrichia mali* from Mali reveals that this genus is synonymous with *Catoxyethira*.

As independently noted by Morse (1974), *Catoxyethira* has a number of structural affinities with the Holarctic genus *Stactobiella* especially with regard to the adult spur formula, thoracic nota and male genitalia. Although the latter are very specialized in *Catoxyethira* they may be derived from the basic stactobiine form. As Morse points out, however, further studies are needed to clarify the taxonomic limits of the genera.

Hydroptila formosae Iwata from Taiwan (Formosa) was described from the larva and case only, according to which Nielsen (1948) and Ulmer (1957 : 186) suggested that the species might belong in *Catoxyethira*. However, neither Nielsen nor Ulmer formally transferred the species which was done without reasoning by Fischer (1971) in his catalogue. Thus the species remains in *Catoxyethira* until examination of additional material can establish its true identity.

The generic diagnosis is based on examination of the following material (all in BMNH collections except where otherwise stated): *fasciata* (UHZIM); *pinheyi* (♂ type); *improcera* and *ocellata* (paratypes); undetermined species (*Medler*).



Figs 74–82 Stactobiini. 74–81, larvae and cases. 74–75, *Stactobia* (adapted from Vaillant, 1951b), (74) larva, dorsal view; (75) case, ventral view. 76, *Lamonganotrichia*, case, dorsal view (after Ulmer, 1957). 77–78, *Plethus cruciatus* Ulmer (after Ulmer, 1957), (77) larva, dorsal view, and foreleg, lateral view; (78) case, dorsal view. 79–80, *Stactobiella*, (79) case, lateral view; (80) larval tarsus, lateral view. 81, *Catoxyethira*, case, dorsal and end-on views (after Ulmer, 1912b). 82, *Madi-oxethira*, ♀ genitalia, ventral view.

DIAGNOSIS. Adult. Forewing length 1.5 mm: head and thorax as in *Stactobiella* (Fig. 62): ocelli 3 (cf. absent according to Ulmer, 1912b): spur formula 1.3.4 (cf. 0.3.4 according to Ulmer, 1912b): ♂ genitalia (Fig. 68) very specialized (main diagnostic feature of genus); sternite VIII elongate with a pair of posterior dorso-lateral spines; IX reduced, withdrawn into VIII, sternite may be present although small and fused with tergite, anterior apodemes narrow and produced beyond VIII; inferior appendages may be present (fused with tergite X in *veruta*); tergite X semimembranous in *veruta*, membranous and covered in microscopic setae in *pinheyi*; aedeagus long, straight, tapering to acute apex (Fig. 73) (the characteristic features of the male genitalia of *fasciata*, *pinheyi* and *veruta* are summarized by Morse, 1974).

Larva. Young larva 1.2 mm long, fifth instar 2.5 mm. According to Ulmer (1912b) the larva is somewhat similar in appearance to that of *Stactobia* from which it may be distinguished by the absence of the posterior 'crenellations' of tergite IX (cf. Fig. 74), the short spines of the posterior margin of tergite VIII and stout spines on tergites VIII and IX. According to Iwata (1928) *formosae* has sternites on abdominal segments III–V which do not occur in the African species of *Catoxyethira* and appear to be unique to this species within the Hydroptilidae.

Case (Fig. 81). According to Ulmer (1912b) this resembles the 'shield-case' of *Molanna* Curtis (Molanidae: Trichoptera) as it is dorso-ventrally flattened and has a central tubular region from which arise

the lateral 'wings'. The case, constructed of silk and fine sand-grains, tapers anteriorly and posteriorly and is attached to the substrate by the edges of the 'wings'.

BIOLOGY. Nothing is known of the biology of *Catoxyethira* but, from the dorso-ventrally flattened larva and fixed case, it would seem likely that the larva lives in fast-flowing water habitats such as swift streams (somewhat stony?). Ulmer's (1912*b*) specimens were taken from a tributary of the Butagu, Ruwenzori West (Zaire) at 1800 m, February 1908; the adults of *improcera* and *ocellata* (Statzner, 1977) were from a 'spring-brook' community (Kalengo stream, Zaire) and the larvae of *formosae* were taken in 'rapid mountain streams' (Iwata, 1928).

DISCUSSION. The form of the adult head and thorax indicate that *Catoxyethira* belongs to the *Stactobiella*-group of the Stactobiini. Discounting the dubious Taiwan species *formosae*, *Catoxyethira* appears to contain five exclusively African species which are characterized by the highly specialized and distinctive male genitalia. The uniqueness of the latter within the *Stactobiella*-group suggests that the ancestors of *Catoxyethira* reached Africa quite early in the history of the group and there evolved as a more tropical, warm-adapted line in isolation from the basic temperate stock. The recent discovery of a number of new species, all collected in considerable numbers, indicates that the genus is more widespread and successful than may have previously been thought.

Genus *PARASTACTOBIA* Schmid

Parastactobia Schmid, 1958*a* : 48. Type-species: *Parastactobia talakalahena* Schmid, by original designation and monotypy.

DISTRIBUTION. S. Asia (Sri Lanka).

Parastactobia is known only from the type-species in which the male genitalia are unique and difficult to homologize with those of any other hydroptilid. Examination of the female paratype (loaned by the USNM) has revealed that, contrary to Schmid's original description, three ocelli are present and that the thorax most closely resembles that of the *Stactobiella*-group (assuming that the female had correctly been associated with the male type). The immature stages are unknown.

DIAGNOSIS. *Adult.* Forewing length 1.75–2.25 mm: head and thorax as in *Stactobiella* (cf. Fig. 62); ocelli 3: spur formula 0.3.4: ♂ genitalia distinct (after Schmid, 1958*a*); segment IX with a large ventral notch (in which sternite VIII is completely encased) and a long asymmetrical dorsal spine and two tapering ventral appendages; tergite X reduced; aedeagus large with paired internal supports and a very complex apex.

BIOLOGY. Schmid (1958*a*) records the adults from beside a small, stony, fairly calm river in a dense forest in a small montane locality.

DISCUSSION. Little can be said regarding the relationships of *Parastactobia* until more adult (and larval) material is available for study. If the female paratype examined had been correctly associated with the male type then the genus would appear to be a highly specialized member (with respect to the male genitalia) of the *Stactobiella*-group as suggested by the structure of the head and thorax. I do not agree with Schmid (1958*a*) that the male genitalia resemble those of *Macrostactobia* (q.v.).

Genus *MADIOXYETHIRA* Schmid

Madioxyethira Schmid, 1960 : 89. Type-species: *Madioxyethira milinda* Schmid, by original designation and monotypy.

DISTRIBUTION. S. and SE. Asia (Pakistan, Nepal, Sarawak); Africa (Zaire, Congo).

Schmid erected this genus for the type-species from Pakistan. Kimmins (1964) described *nepalensis* from Nepal and Statzner (1977) has described a new species from Zaire (*marshalli*) which, on the basis of affinities of the metascutellum and the male and female genitalia, he has placed in *Madioxyethira*. The occurrence of the genus in the African continent is supported by the opinion that *Hydroptila trifurcata* Jacquemart from the Congo should rightly belong in *Madioxyethira*

according to the form of the male genitalia (however, the figures given by Jacquemart (1962a) are not easy to compare with those of established species). The immature stages are unknown.

A ♂ of what is possibly a new species of *Madioxyethira* was recently collected in Sarawak, 1978 (J. E. Marshall), in BMNH.

The following diagnosis is based on examination of the male type of *nepalensis* and a female paratype of *marshalli* (BMNH coll.).

DIAGNOSIS. *Adult.* Forewing length 2.25–3.25 mm: head and prothorax typical of the Stactobiini although the metascutellum (Fig. 64) is intermediate between those of *Stactobia* and *Stactobiella* (Figs 62, 63) and the postoccipital lobes are characteristically narrow: ocelli 3: spur formula 1.2.4, fore-tibial spur reduced to a small subspherical process (diagnostic): ♀ genitalia a typical oviscapit but with a characteristic loop in the anterior duct of the internal system (Fig. 82): ♂ genitalia very complex and difficult to homologize (Fig. 67); segment IX relatively small but produced anteriorly as a long point into the preceding segments; inferior appendages large, concave and ventrally prolonged as a unique plate which terminates on sternite VII; segment X forming two lateral obtuse plates ('bourrelet bombé' of Schmid, 1960) which Kimmins (1964) considers to be prolongations of tergite IX (Kimmins also considers that the 'inferior appendages' may have arisen from the fusion of sternites VIII and IX and the true inferior appendages); the aedeagus is narrow and simple in *milinda* while in *nepalensis* it has a complex apex divided into two narrow foliate lobes with two narrow divergent spines (Fig. 71).

BIOLOGY. According to Schmid (1960) *milinda* is common and abundant in parts of Pakistan between 1450 and 3000 m and its habits are exclusively malicolic (although Schmid did not collect or, therefore, examine larvae).

DISCUSSION. As will be shown later, *Madioxyethira* may prove to be synonymous with *Pseudoxyethira* Schmid and *Scelotrichia* Ulmer (in which case the last name takes priority). Schmid (1960) remarked on the possible synonymy of *Madioxyethira* and *Pseudoxyethira* since he could only distinguish these genera (apart from using genitalic features) on the venation of the hindwings, especially with respect to vein *ScR*.

Genus *PSEUDOXYETHIRA* Schmid

Pseudoxyethira Schmid, 1958a : 44. Type-species: *Pseudoxyethira asgiriskanda* Schmid, by original designation and monotypy.

DISTRIBUTION. S. Asia (Sri Lanka).

Only the adult stages of this highly specialized genus, represented by a single species from Sri Lanka, are known. Examination of a paratype female (USNM) reveals that the mesoscutellum and postoccipital lobes are identical to those of *Madioxyethira* (q.v.) (the specimen was returned before the significance of the fore-tibial spur and genital-duct loop were discovered and these were therefore not investigated).

DIAGNOSIS. *Adult.* Forewing length 2.75–3.00 mm: head and thorax as in *Madioxyethira* (Fig. 64): ocelli 3: spur formula 0.2.4 (according to Schmid, 1958a): ♂ genitalia very specialized with the ventral half of segment IX extending anteriorly as a plate to the middle of sternite VII, but not invaginated into the preceding segments; dorsal half of segment IX massive; appendages absent; aedeagus 'long and spiniferous' (Fig. 72).

BIOLOGY. According to Schmid (1958a) the adults frequent rivers at moderate altitudes and also elevated regions; they run about on rocks on the river banks.

DISCUSSION. If, as Schmid (1960) suggests, this genus is synonymous with *Madioxyethira* (q.v.) the name *Pseudoxyethira* takes priority. However, this is complicated by the possibility that *Scelotrichia* (see below) may also be a synonym since this would then take precedence.

Genus *SCELOTRICHIA* Ulmer

Scelotrichia Ulmer, 1951 : 73. Type-species: *Scelotrichia saranganica* Ulmer, by original designation and monotypy.

DISTRIBUTION. Indonesia (Java).

Only two male specimens of the type-species of this genus are known. The type-specimen of *saranganica* (UHZIM) was examined but was not in a condition favourable for the recognition of

critical features; however, the postoccipital lobes resemble those of *Madioxyethira* and the mesoscutellum has a transverse suture. The following diagnosis is partly adapted from Ulmer (1951).

DIAGNOSIS. *Adult.* Forewing length 2.8 mm: head as in *Madioxyethira* (Fig. 64): thorax with transverse mesoscutellar suture (cf. Fig. 62): ocelli 3: spur formula 1.2.4, fore-tibial spur minute (Ulmer, 1951: pl. 2, figs 31B, C): ♂ genitalia difficult to interpret from Ulmer's figures.

DISCUSSION. According to features of the head and mesothorax, *Scelotrichia* is a member of the Stactobiini. The shape of the postoccipital lobes and the presence of a small fore-tibial spur (and also the general appearance of the male genitalia) indicate that the genus may be very close to, if not synonymous with, *Madioxyethira* and *Pseudoxyethira* (see above); in that case the senior name would be *Scelotrichia*. Further examinations of material and discovery of the larval stages are required to establish the true identities of these genera.

Tribe **LEUCOTRICHINI** Flint **stat. n.**

Leucotrichinae Flint, 1970: 2. Type-genus: *Leucotrichia* Mosely, 1934.

DISTRIBUTION. North, Central and South America.

Flint (1970) erected the subfamily Leucotrichiinae (as Leucotrichinae) for the distinct group of Nearctic and Neotropical hydroptilids consisting of *Leucotrichia* and its closely related genera. Since the group has many of the features characteristic of the Hydroptilinae in general it is considered here at the status of tribe.

The tribe is predominantly of Central American distribution (including the West Indies) although a few species occur in North America while some are found as far south as Chile in South America; the latter continent is very under-collected and will undoubtedly yield many new species.

Flint (1970) stated that he could give no single character by which the group could be distinguished from other hydroptilids in the adult stages but he did list the following as being diagnostic when present: ocelli reduced to 2; head modified; antennae modified; reflexed costal cell (basal costal 'pouch' or 'bulla') present on male forewing. Flint did not define the basic structure of the male genitalia although, in his words, 'there is . . . something characteristic' about their form. As will be shown in the diagnosis given below, the adults of the Leucotrichiini do possess a number of distinguishing features which clearly set the group apart from the other hydroptiline tribes; the larvae (at least in those genera which are known) also appear to be very distinct due to their structural modifications associated with their torrenticolous habits. The following list of diagnostic adult and larval characters has been based on an examination of Mosely's type-material (BMNH) and a study of Flint's (1970; 1972b; 1974) papers on *Leucotrichia* and related genera.

The tribe Leucotrichiini is considered to contain those genera originally included by Flint (1970), with the addition of *Celaenotrichia*, of which Flint considered *Alisotrichia* to be distinct according to features of the male aedeagus, the female genitalia and the larval stages. The tribe thus contains the *Leucotrichia*-group: *Leucotrichia*, *Zumatrichia*, *Peltopsyche*, *Anchitrichia*, *Costatrichia*, *Acostatrichia*, *Betrichia*, *Abtrichia* and *Celaenotrichia*, and the *Alisotrichia*-group: *Alisotrichia*.

DIAGNOSIS. *Adult.* Forewing length 1.2–4.0 mm; wings brilliantly coloured, sometimes spangled with green and silver; the male forewing sometimes has a basal costal pouch (bulla) which may contain modified setae; head and tentorium well developed, former often with modifications in the male; antennae generally short, of approximately 13–20 segments, male basal or median segments sometimes modified; ocelli 3, often reduced to 2 in the male (rarely also in the female); mesoscutellum with transverse suture; metascutellum pentagonal or subtriangular: spur formula 1.3.4 (except *Alisotrichia*, 0.2/3.3/4): fifth abdominal segment with typical lateral setose processes: ♀ genitalia a simple oviscap, internal apparatus well developed (in *Alisotrichia* segment VII is modified and the internal apparatus is simple and 'ring-like'): ♂ genitalia (Fig. 84) often with ventral processes; sternite VIII distinct, produced posteriorly beneath segment IX, sometimes with postero-lateral processes; segment IX fused, incomplete ventrally, sometimes with postero-lateral processes; inferior appendages narrow, short, rod-like, basically unmodified but sometimes fused medially and bearing baso-dorsal bracteoles; tergite X membranous or well sclerotized, fused latero-ventrally with the subgenital appendages which may be indistinct or developed as heavily

sclerotized plates; latter fused ventrally with subgenital plate which may be produced ventrally and may articulate with an unidentified structure lying between the inferior appendages; aedeagus (Fig. 84) an elongate tube with a median constriction and (except in *Alisotrichia*) a complex medial structure consisting of a basal loop and a pair of basally directed processes, sometimes with a pair of circular 'windows' in lateral view, apex membranous with various spinose processes and lateral plates.

Larva (Figs 85–89, 92). Larvae have been associated with *Leucotrichia*, *Zumatrichia*, *Peltopsyche*, *Anchitrichia*, *Abtrichia* and *Alisotrichia*; they typically exhibit hypermetamorphosis (Flint, 1970), the early instars being entirely free-living and caseless. From a specimen of what would appear to be a young larva from a small collection of *Peltopsyche sieboldii* Müller (BMNH collection), the early stages are dorso-ventrally flattened with slender, tapering abdomens and short, robust clinging legs; there is a single tergite on each abdominal segment and the long, slender anal prolegs project laterally from the sides of segment X. In all genera (except *Alisotrichia*) the final (fifth) instar builds a permanently fixed case in which it remains throughout the stage. The fifth instar exhibits structural modifications suiting it for such a sedentary existence in comparison with the earlier free-living stages: the body again is dorso-ventrally flattened; the ecdysial lines of the rugose or papillate head are variously fused, as are those of the meso- and metathoracic nota; the legs are short and robust; the abdomen is distended, especially segments V and VI which are abruptly enlarged, and small tergites are present on segments I–VIII while tergite IX is large, shield-shaped and sometimes bears enlarged spine-like setae; the anal prolegs are fused to the sides of segment X, the claws alone being free. The genus *Alisotrichia* is unique in that the fifth instar larva does not construct a case until just prior to pupation. The larva accordingly retains the structural adaptations of the earlier stages (cf. Figs 92, 51) with a slender, tapering abdomen, large abdominal tergites (i.e. relative to the size of the segments) and long, slender, freely projecting anal prolegs which are not fused to the sides of segment X.

Case (Fig. 86). The cases of the Leucotrichiini are said to resemble leech egg-cases. They are strongly depressed dorso-ventrally and composed of tough secretion, rarely embedded with small inorganic particles, and sometimes with transverse strengthening ridges; the dorsal surface is slightly vaulted while the flat ventral surface is firmly attached to the substrate; there is a small circular opening at either end.

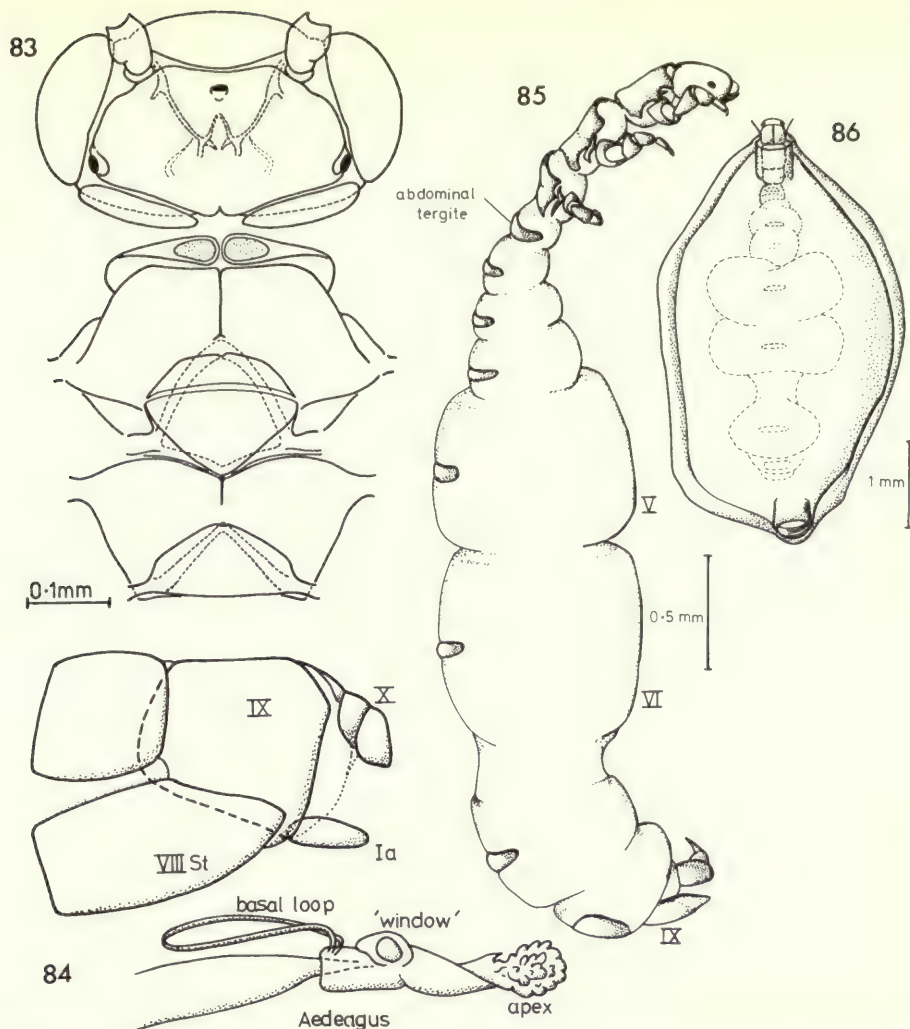
Pupa. Typically hydroptilid: mandibles long, without teeth. The pupal case varies between genera and species but basically resembles the larval case with sealed anterior and posterior ends. In *Alisotrichia hirudopsis*, where the case is not built until just before pupation, the central suboval region is surrounded by an irregular flange by which the case is attached to the substrate and which has two to six small round openings (possibly for water circulation according to Flint, 1964; 1970). In *A. spangleri* the pupal case is torpedo-shaped and is attached to the substrate from one end by a silk thread 2–8 mm long (Flint, 1970); in this way the case floats freely just below the surface of the water and this may serve to prevent desiccation due to fluctuating water levels (Flint, 1970).

BIOLOGY. The larvae (early and fifth instars) are adapted to live in torrenticolous conditions, usually being found in great numbers on boulders in the rapid sections of fast-flowing rivers. Some are also found in the thin surface film of water on partly exposed rock surfaces moistened by spray from nearby cascades (similar to the madicolous habitat of *Stactobia*). Structural modifications include dorso-ventral flattening, fixed cases, well-developed and fused sclerites, protective spinose setae and short robust clinging legs.

The larvae are reported to feed on 'periphyton' and small particles of detritus on the surrounding rock surfaces. In the case-dwelling forms the larva extends its slender anterior end through either of the narrow case openings and grazes on the immediate surroundings. The larva never leaves the case and this, in the later stages of the instar, would be impossible anyway due to the distension of the middle abdominal larval segments. The retention of the free-living habit by the final instar of *Alisotrichia* may be an adaptation serving to increase the feeding range of the larva. In all genera the mandibles are adapted for scraping and grazing as they are strong with blade-like, sometimes dentate, edges.

The adaptation of the pupal case of *Alisotrichia spangleri* for the prevention of desiccation due to fluctuating water levels shows a remarkable parallelism with that of the larva of *Rhyacopsyche hagenii* which also inhabits a torpedo-shaped case anchored by a thread to the substrate; however, in this species, the pupal case is fixed.

Adult Leucotrichiini are reported to be most active on the exposed parts of the rocks on which the larvae dwell. They prefer bright sunlight and congregate on the rock surfaces and run around often describing semicircular paths. Such habits are typical of hydroptilids in general.



Figs 83–86 *Leucotrichia*. 83, adult head and thorax, dorsal view; 84, generalized ♂ genitalia, lateral view (vide Figs 15, 16); 85, larva, lateral view; 86, larva in case, dorsal view.

DISCUSSION. As can be seen from the generic key, couplets 13 to 19, it has not been possible to define the genera of the Leucotrichiini satisfactorily since species from two or more genera often key out with one another (e.g. *Abtrichia* and *Betrichia*; *Costatrichia* partim, *Betrichia* partim, *Leucotrichia* partim and *Celaenotrichia*). Flint (e.g. 1972b; 1974) appears to be very inconsistent in his choice of criteria when assigning new Neotropical species to genera, using features of the head, antennae and wings in some cases and genitalic features in others. Genera were originally erected on the basis of certain (then apparently distinctive) characters common to a group of species from a particular geographical area but, as new species have been discovered from other areas, the generic limits do not appear to be so clear-cut. The larval generic key is also very unsatisfactory at present since it is based on only a few species of each genus (only one in some cases and, in *Anchitrichia*, association with adults is purely assumptive). The tribe is thus in need of a thorough review which, however, would probably best be done by American workers due to the location of most of the material.

In general, however, the Leucotrichiini appears to form a distinct group within the Hydroptilinae and is characterized by a number of both adult and larval features. The origins of the tribe

are speculative but the ancestral form appears to have given rise to a very specialized group with an essentially Central American distribution. In this region the ecological conditions favour short generation cycles resulting in high speciation rates and species diversity.

The tribe has greatest superficial affinities with the essentially Old World Stactobiini, particularly the *Stactobia*-group. Common adult features are the short antennae, the transverse meso-scutellar suture (cf. Figs 62, 83) and the simple basic form of the male genitalia (cf. Figs 65, 84) while the larvae are similarly dorso-ventrally flattened, have clinging legs, protective abdominal tergites, modified setae and fixed cases (cf. Figs 74, 75, 77, 78, 85–87, 92). However, the larval similarities between the Leucotrichiini and the *Stactobia*-group are probably due to their comparable madicolous habits since they are all functional and protective adaptations to living in this type of aquatic habitat and are also seen in a number of unrelated insect groups (see Vaillant, 1956; Hynes, 1970). The larvae of the two tribes may be distinguished by certain fundamental differences in, for example, the form of the head, the complete fusion of all thoracic nota (i.e. medially) and the characteristic enlargement of the abdomen in the Leucotrichiini; the cases of the Leucotrichiini do not have dorsal and ventral seams and are of a different shape. The adults differ in the shape of the metascutellum, the reduced spur formula of the Stactobiini and the different modifications of the male genitalia.

Nevertheless, the Leucotrichiini and the Stactobiini appear to have more in common with one another than with any other group of hydroptilids and may have arisen from a common ancestor very early in the evolutionary history of the Hydroptilinae. This common ancestor may have arisen in the Old World temperate region and given rise to two main lines, one of which colonized the cool, montane streams of the Palaearctic and Palaetropical regions (the present-day Stactobiini) while the other penetrated the American continent (probably via the Bering connection) and passed down to the Central American region where the descendants of these early arrivals evolved into the highly successful Neotropical Leucotrichiini.

However, this hypothesis is tentative and further evidence from new species and distribution records is required in order to present a more accurate picture of the evolutionary history of the Leucotrichiini. The tribe may prove to be more distantly related to the Stactobiini than indicated above, the morphological similarities being the result of convergent rather than parallel evolution. In conclusion the Leucotrichiini is a very specialized and successful member of the Hydroptilinae which has a predominantly Central American distribution and may share a common ancestry with the Stactobiini.

Genus *LEUCOTRICHIA* Mosely

Leucotrichia Mosely, 1934 : 157. Type-species: *Leucotrichia melleopicta* Mosely, by original designation.

DISTRIBUTION. North and Central America and the Antilles.

Leucotrichia contains ten species of predominantly Central American distribution although *sarita* and *limpia* have been recorded from the southern United States, while *pictipes* is widespread throughout the U.S.A. (but not so far recorded from Canada). The larva of *pictipes* was first described by Lloyd (1915) (as *Ithytrichia confusa*) and larvae have now been associated with all species except *melleopicta*, *virida* and *fairchildi*.

DIAGNOSIS. *Adult.* Forewing length 2–5 mm: dorsal region of head sometimes modified; ocelli 3 or 2 (♂ only); metascutellum pentagonal (Fig. 83); wings unmodified; spur formula 1.3.4: ♂ genitalia simple (Fig. 84) with a single posterior spine or paired setal brushes on sternite VII; sternite VIII posteriorly produced beneath segment IX; IX completely open ventrally, postero-lateral margin with a row of stout setae; tergite X heavily sclerotized; subgenital plate connected dorsally to tergite X and produced ventrally as a narrow, elongate mesal sclerite which projects down to the base of the inferior appendages; subgenital appendages small, semimembranous; inferior appendages unmodified, elongate and usually fused meso-ventrally; aedeagus with median complex and spinous, membranous sac-like apex (Fig. 84).

Larva (Fig. 85). Typical of the Leucotrichiini but with the following characteristics: head rugose or papillate; pronota with antero-lateral angles not produced; femora with spiniform dorsal setae, tarsal claw single; abdominal tergites II–VII smaller than in *Zumatrichia*, without central pores; tergite IX rarely with enlarged basal setae (after Flint, 1970).

Case (Fig. 86). Typically flat, silken, ovoid and slightly domed.

BIOLOGY. According to Wiggins (1977) the larvae occur on rocks in strong currents of running water where they graze on the surrounding periphyton and detritus. Collection data indicate that *pictipes* probably overwinters as a final instar larva and pupates from May to August.

SPECIES-GROUPS. Flint (1970) splits the genus into two main species-groups on the basis of adult features.

The *melleopicta*-group is characterized by the three ocelli in both sexes, the unmodified male head (except in *chiriquiensis*) and the single process of sternite VII in the male.

The *pictipes*-group is distinguished by the males having only two ocelli, a modified head (except in *imitator*) and a brush of setae or a point on sternite VII.

Flint (1970) gives keys to the males of all species and to all described larvae.

Genus *ZUMATRICHIA* Mosely

Zumatruchia Mosely, 1937 : 187. Type-species: *Zumatruchia filosa* Mosely, by original designation.

DISTRIBUTION. North and Central America and the Antilles.

Zumatruchia contains 18 species of essentially Central American distribution although *notosa* is known from Montana only and was originally described in *Leucotrichia*. The immature stages are known only for *antilliensis*, *anomalopecta* and *multisetosa*.

DIAGNOSIS. *Adult.* Forewing length 2.5–4.0 mm: head unmodified; ocelli 2 (♂), 3 (♀); male basal antennal segment elongate, enlarged, with a 'button-like' appendage which covers half of the slightly concave face (cf. Fig. 91); mesoscutellum pentagonal; wings unmodified; spur formula 1.3.4: ♂ genitalia (cf. Fig. 84) with a short ventral process on sternite VII; sternite VIII produced beneath segment IX, sometimes with a pair of lateral processes; segment IX open ventrally with a postero-lateral lobe or process; tergite X is heavily sclerotized and sometimes produced posteriorly; subgenital appendages large and plate-like, fused with subgenital plate ventro-medially; inferior appendages usually fused baso-medially and often with a baso-dorsal bracteole; aedeagus with median complex and membranous apex bearing spines and plates.

Larva (Fig. 87). Typical of the *Leucotrichiini* but distinguished by the rugose, but non-papillate, head; simple pronota; femora with spiniform baso-dorsal setae (according to Wiggins, 1977, paired tarsal claws are present in *antilliensis*); abdominal tergites larger than those of *Leucotrichia* and with paired contiguous central pores; tergite IX covered in short, stout, spinous setae.

Case. Typically flat, silken (sometimes with embedded sand-grains), ovoid and dome-like (cf. Fig. 86).

BIOLOGY. Wiggins (1977) states that the larvae inhabit fast-flowing sections of running-water (preferring larger rivers according to Flint, 1968a). The larvae of *antilliensis* have successfully adapted to living on boulders in the fast-flowing sections of the larger lowland rivers of Dominica (Flint, 1968a).

SPECIES-GROUPS. Flint (1970) splits the genus into five species-groups (here reduced to four) on the basis of features of the male genitalia.

The *multisetosa*-group (lobe of segment IX multisetate).

The *galtena*-group (sternite VIII without lateral processes, bracteole present).

The *filosa*-group (sternite VIII with lateral processes, no bracteole).

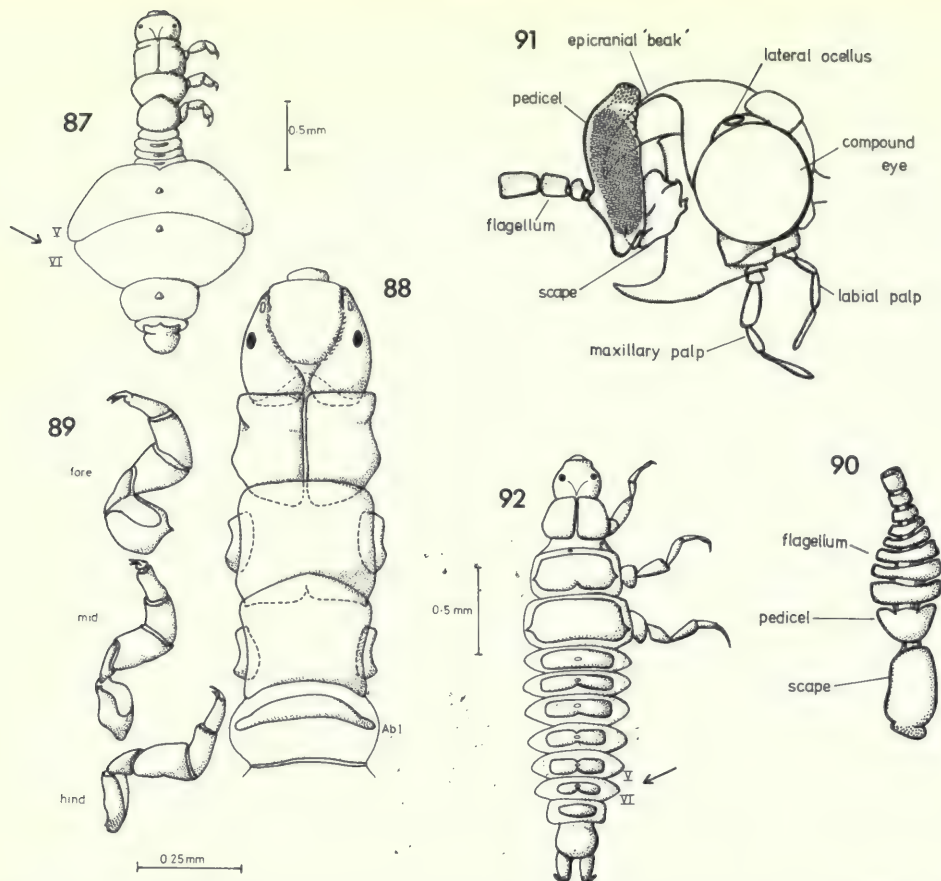
The *palmaria*-group (sternite VIII with lateral and ventral processes, bracteole present; Flint, 1970, distinguishes *anomalopecta* and *palmaria* on the colour and structure of the forewing only).

Genus *PELTOPSYCHE* Müller

Peltopsyche Müller, 1879c : 144. Type-species: *Peltopsyche sieboldii* Müller, by subsequent designation by Fischer, 1961.

DISTRIBUTION. Brazil.

This genus is known only from descriptions and crude figures of two species collected by Müller from the Santa Catarina region of southern Brazil. Although Müller (1879b; 1879c; 1880) gave a general account of the habitat and adults he only figured the general larval form and the basal antennal segments of the males of both species. Thus, since Müller's original adult specimens have not been traced, the genitalia and, therefore, the true identities of the two species remain unknown. However, I have been able to examine larvae and cases of *sieboldii* which were sent to McLachlan by Müller and are now in the BMNH collection.



Figs 87–92 Leucotrichiini. 87, *Zumatrichia antillensis* Flint, larva, dorsal view (after Flint, 1970). 88–89, *Peltopsyche sieboldii* Müller, larva; (88) head and thorax, dorsal view; (89) thoracic legs, lateral views. 90, *Costatrichia lodora* Mosely, ♂, basal antennal segments; 91, *Abtrichia squamosa* Mosely, ♂, head, lateral view (after Mosely, 1939c); 92, *Alisotrichia hirudopsis* Flint, larva (fifth instar), dorsal view (after Flint, 1970).

The actual spelling of the name of the type-species is in need of clarification. Müller continually used *sieboldii* except in a communication to McLachlan which was published in the Proceedings of the Royal Entomological Society (Müller, 1879b) where he used *sieboldi*. *P. sieboldi* was used by Ulmer (1907) and Fischer (1961) lists the species under this name with all of Müller's references to *sieboldii* being treated as synonyms even though Fischer was aware that *sieboldii* was the first published name. I therefore propose to accept Müller's original orthography.

The following diagnosis is based on Müller's original descriptions with additional observations on the larvae in the BMNH collection. The genus is clearly a member of the Leucotrichiini according to the general appearance of the larvae and the modified male antennae.

DIAGNOSIS. Adult. According to Müller the adults are distinguished by the modified basal segments of the male antennae (13-segmented, longer in the female). In *maclachlani* the second segment is merely somewhat longer and wider than the others, but in *sieboldii* this segment is enlarged, ovoid and bears a small, rounded process as in *Zumatrichia*. Müller suggests that these structures may have an 'odoriferous' function. The spur formula is quoted as 2.4.4 but this may be an error, the usual leucotrichiine count being 1.3.4.

Larva (Figs 88, 89). According to Müller's descriptions and figures the abdomen of the larva is greatly distended in segments V–VII and fills nearly the entire case (cf. Figs 85, 87) and is thus typical of the Leucotrichiini. Examination of the BMNH specimens of *sieboldii* (dried and originally glued to card)

reveals that the general morphology is very similar to that of *Zumatrichia* with respect to the head, legs, thoracic nota, wide abdominal tergites (with their paired contiguous central pores) and the short, stout spines of segment IX; unlike *Z. antilliensis*, however, the tarsal claws are unpaired, according to Wiggins (1977).

Case. This is identical to that of *Leucotrichia*, being ovoid and flattened ('leech egg-case' case); the dorsal surface is transversely ridged in *sieboldii* and smooth in *maclachlani*.

Pupa. According to Müller this is remarkable for the unusually great difference in the 'complicated cornus patches dorsally on the abdomen' between the two species. He is probably referring to the pre- and postsegmental dorsal abdominal plates but, since Müller does not describe the specific differences, I cannot comment on their significance.

BIOLOGY. The cases were found in very large numbers fixed to the upper side of stones in rapids in the larger tributaries of the Itahajy (Garcia, Encana, Warnow, etc.), Santa Catarina. *P. maclachlani* was only found in a single rapid near the mouth of the Warnow along with *sieboldii*.

DISCUSSION. *Peltopsyche* may prove to be a senior synonym of one or more genera of the Leucotrichiini described subsequently by Mosely and Flint (see later discussion).

Since Müller obviously encountered what he identified as *sieboldii* in a number of localities more than one species may be involved; this problem will only be resolved when Müller's original material has been located and examined.

Genus *ANCHITRICHIA* Flint

Anchitrichia Flint, 1970 : 14. Type-species: *Anchitrichia spangleri* Flint, by original designation and monotypy.

DISTRIBUTION. Central America (Mexico, Guatemala, Honduras, Costa Rica, Panama).

This genus contains only the type-species and is very closely related to *Zumatrichia* from which it is distinguished by a number of adult features including its relatively larger size (4–5 mm forewing length), its habit of holding its wings roof-like over the body, the unmodified antennae, the presence of 2 ocelli in both sexes, and the general form of the male genitalia (cf. Fig. 84). The larva, described by Flint (1970), was not reared but associated 'by supposition' and is distinguished by the bilobed anterior margin and postero-medial process of the frontoclypeus, the enlarged antero-lateral angles of the pronota, the arborescent baso-dorsal seta of the femur and the form of the abdominal tergites. The larval case is typical of the Leucotrichiini but has an enlarged, transversely oval, protective hood at one end and a flared collar at the other. The pupal case is unique in that it is quite unlike that of the larva, being torpedo-shaped and attached at one end to the substrate by a silk strand 2–8 mm long. In this way the case floats just below the surface of the water and may be an adaptation to prevent desiccation due to fluctuating water levels and appears to parallel the condition seen in the larval case of *Rhyacopsyche* (Fig. 99).

The true status of *Anchitrichia* has yet to be established; the examination of more species is required to define the limits of the genus. It may prove to be synonymous with one or more of the other leucotrichiine genera.

Genus *COSTATRICHIA* Mosely

Costatrichia Mosely, 1937 : 166. Type-species: *Costatrichia lodora* Mosely, by original designation and monotypy.

DISTRIBUTION. Central America.

Costatrichia was erected for a single Mexican species and now contains three additional species from Panama (Flint, 1967a; 1970), one from Nicaragua and one from El Salvador (Flint, 1970). The immature stages are unknown.

DIAGNOSIS. *Adult.* Forewing length 2.0–2.5 mm; head unmodified; ocelli 3; basal antennal segments simple, middle segments sometimes broad and flat (Fig. 90); metascutellum subtriangular; forewing often with basal costal 'bulla' (Fig. 10); spur formula 1.3.4; ♂ genitalia (cf. Fig. 84) with lateral processes often on sternite VIII; segment IX with setose postero-lateral processes; tergite X strongly sclerotized and fused with segment IX; subgenital appendages elongate, separate, often with baso-dorsal bracteoles; aedeagus with median complex and spinose membranous apex.

SPECIES-GROUPS. Flint (1970) splits the genus into two distinct species-groups on the basis of features of the male genitalia, head and wings.

The *simplex*-group (*simplex*, *spinifera*): unmodified antennae, no basal costal bulla.

The *lodora*-group (*lodora*, *panamensis*, *tripartita*, *bipartita*): modified antennae, basal costal bulla present.

Flint (1970) gives a key to separate the males of all six species. He distinguishes the genus from *Zumatrachia* by the presence of three ocelli and the unmodified basal segments, but sometimes modified middle segments, of the male antennae.

Genus *ACOSTATRICHIA* Mosely

Acostatrachia Mosely, 1939c : 228. Type-species: *Acostatrachia plaumanni* Mosely, by original designation.

DISTRIBUTION. South America (Brazil, Surinam).

Mosely erected this genus for two south Brazilian species, *plaumanni* and *simulans*, and Flint (1974) later described three new species from Surinam. The immature stages are unknown.

DIAGNOSIS. *Adult*. Forewing length 2.0–2.5 mm: head unmodified; ocelli 3; antennae unmodified; forewing with basal costal pouch (cf. Fig. 9) filled with broadened hairs: spur formula 1.3.4: ♂ genitalia (cf. Fig. 84) usually with two short ventral processes on segment VII; sternite VIII with postero-lateral processes; inferior appendages sometimes with bracteoles; aedeagus with median complex and spinose membranous apex.

DISCUSSION. The three Surinamese species are said by Flint (1974) to resemble the two original Mosely species although the basic form of the male genitalia is slightly different (but not enough to warrant the erection of a new genus). According to Flint, *fimbriata* is closest to *brevipennis*, while *spinifera* resembles *simulans* and *plaumanni*. As Mosely (1939c) points out, the genus is closely related to *Costatrachia* Mosely, differing only in features of wing venation and in having unmodified antennae but, again as noted by Mosely, these may be specific rather than generic characteristics (see later discussion). The larvae will probably prove to be of the general *Leucotrachia* type, as will those of *Costatrachia*.

Genus *BETRICHIA* Mosely

Betrachia Mosely, 1939c : 230. Type-species: *Betrachia zilbra* Mosely, by original designation and monotypy.

DISTRIBUTION. South America (Brazil, Argentina).

Erected for a single Brazilian species, this genus now also contains *argentinica* from north Argentina and *surinamensis*, *bispinosa* and *occidentalis* from Surinam (Flint, 1972b; 1974).

Mosely gives no precise reasons for erecting this genus but it may be assumed that it was mainly on account of venational and antennal features as well as the general form of the male genitalia; in the male type-specimen (BMNH) there are 2 ocelli, the antennae are 19-jointed with an elongate basal segment. Flint (1972b) places *argentinica* in this genus on genitalic features alone although there are 3 ocelli and the antennae are simple. Of Flint's (1974) Surinamese species only *occidentalis* resembles the type-species, while in *surinamensis* the head is greatly modified and the genitalia are quite different; in *bispinosa*, although the genitalia resemble those of *zilbra*, the forewing has a basal costal pouch. Flint (1974) states that 'he would prefer to wait until the South American fauna is better known . . . before erecting more genera' but I am of the opinion that all the small leucotrachiine genera, such as *Betrachia*, *Costatrachia* and *Acostatrachia* for example, should be grouped together as the characters originally given as diagnostic generic features are now proving to be specific instead; this, however, will be discussed more fully later. As such no precise diagnosis of the genus *Betrachia* can be given; only the main features are listed below. The immature stages are unknown.

DIAGNOSIS. *Adult*. Forewing length 2–4 mm: head and antennae slightly modified or simple; ocelli 2 or 3: forewing with or without basal costal pouch: spur formula 1.3.4: ♂ genitalia (cf. Fig. 84) with a process on sternite VII; sternite VIII usually without postero-lateral processes: segment IX with or without postero-lateral processes; inferior appendages fused medially; tergite X and subgenital plate variable; aedeagus with median complex and spinose membranous apex.

DISCUSSION. As is evident from the above account this genus is very difficult to key out satisfactorily. As with a number of other genera in the Leucotrichiini all species descriptions must be referred to before a specimen suspected of belonging to *Betrichia* can be positively identified.

Genus *ABTRICHIA* Mosely

Abtrichia Mosely, 1939c : 224. Type-species: *Abtrichia antennata* Mosely, by original designation.

DISTRIBUTION. South America (Brazil, Argentina).

Abtrichia was erected for two very distinct species from southern Brazil, *antennata* and *squamosa*, of which the former has since been recorded, along with its immature stages, from northern Argentina by Flint (1972b). *Abtrichia* is characterized by the highly modified head of the male with the enlarged, process-bearing, basal antennal segment (Fig. 91) and the large basal costal pouches of the male forewings which contain small scales or coarse hairs (Fig. 9). According to Flint (1972b), the larvae bear most resemblance to those of *Zumatrichia antilliensis*, differing only in having a papillate dorsal head surface.

DIAGNOSIS. *Adult*. Forewing length 4 mm: head of male modified with dorsal and ventral anterior beak-like processes (Fig. 91); ocelli 2 (both sexes); antennae 12-jointed in the male with an enlarged, process-bearing, basal segment (Fig. 91); forewing with costal pouch along basal half (Fig. 9); spur formula 1.3.4: ♂ genitalia (cf. Fig. 84) with a short process on sternite VII; sternite VIII and segment IX without postero-lateral processes; subgenital appendages well developed; inferior appendages distinct, with or without bracteoles; aedeagus with median complex and spinose membranous apex.

Larva and case. Typical of the *Leucotrichia*-group.

BIOLOGY. According to Flint (1972b) the cases are tightly attached to rocks in riffles.

Genus *CELAENOTRICHIA* Mosely

Celaenotrichia Mosely, 1934 : 158. Type-species: *Celaenotrichia edwardsi* Mosely, by original designation and monotypy.

DISTRIBUTION. South America (Chile).

C. edwardsi was originally described from Chiloe Island and Flint and Barria have since collected additional specimens (USNM) of which I have examined a female example. From the adult features the genus appears to belong in the Leucotrichiini; it is characterized by the unmodified antennae and forewings and the distinctive genitalia of the male. The immature stages are unknown.

DIAGNOSIS. *Adult*. Forewing length 3 mm: head and antennae simple, latter 26-segmented; ocelli 3: forewings unmodified: mesoscutellum with transverse suture; metascutellum pentagonal: spur formula 1.3.4: ♂ genitalia relatively simple (cf. Fig. 84) with a process on sternite VII; sternite VIII produced postero-ventrally, without postero-lateral processes; segment IX open ventrally with deep postero-dorsal V-shaped cleft enclosing the membranous tergite X which has two narrow longitudinal supporting sclerites; subgenital appendages heavily sclerotized and spinose; subgenital plate well developed; inferior appendages curved inwards, without bracteoles; aedeagus appears to have a median complex (microscope slide preparation of the type-specimen (BMNH) indistinct here), apex membranous and spinose.

Genus *ALISOTRICHIA* Flint

Alisotrichia Flint, 1964 : 46. Type-species: *Alisotrichia hiruopsis* Flint, by original designation and monotypy.

DISTRIBUTION. Central America (including the Antilles).

Alisotrichia contains 12 species, three of which are also known in their larval stages, and is a member of the Leucotrichiini but forms a distinct subgroup according to both adult and larval features. The insects are very small and, although adult characters are somewhat variable, constant diagnostic features include the absence of a fore-tibial spur, the simplified aedeagus and modified tergite VII of the male and the simple internal apparatus of the female genitalia. The larvae are unique within the tribe in that the fifth instars remain free-living until pupation and thus retain the general appearance of the earlier instars of this and other leucotrichiine genera (cf. *Ugandatrichia*). The following diagnosis is adapted from Flint (1970).

DIAGNOSIS. *Adult.* Forewing length 1.2–2.5 mm: basal antennal segment of male often enlarged; ocelli 2 or 3: metascutellum pentagonal to subtriangular: spur formula 0.2.4, 0.2.3 or 0.3.4: ♀ genitalia simple, tergite VII modified (no details or figures given by Flint, 1970), internal apparatus with a simple ring or sphere: ♂ genitalia (cf. Fig. 84) with sternite VIII and segment IX often with postero-lateral processes; inferior appendages, tergite X, subgenital appendages and plate very variable and difficult to interpret; aedeagus simple with a median constriction and a simple to complex internal structure but never with a midlength complex (basal loop, 'windows', etc.).

Larva (Fig. 92). Abdomen not distended, tapering posteriorly; tergites I–VIII covering most of dorsum of each segment and each with three contiguous central pores, tergite IX shield-shaped without pores; anal prolegs long, projecting freely from segment X.

Pupal case (after Flint, 1964, for *hirudopsis*). This is built just prior to pupation and is similar to the typical leucotrichiine larval and pupal case. It is silken, dorso-ventrally flattened, with an ovoid central region (containing the pupa) which is surrounded by an irregular flange which attaches the case to the substrate and has two to six small round openings (for water circulation ? (Flint, 1964)).

BIOLOGY. The larvae of *hirudopsis* are found on rocks in fast-flowing water at various altitudes and occur abundantly on exposed boulders kept wet by the spray from nearby cascades. The adults are also abundant and run about in the sunlight on the dry exposed parts of the rocks on which the larvae live.

SPECIES-GROUPS. Flint (1970) splits the genus into several groups of species on the basis of adult characters such as the number of ocelli, spur formula and antennal modifications. However, as Flint does not define the groups clearly, I have not discussed them here.

DISCUSSION. The fifth instar larva of *Alisotrichia* conforms to the basic leucotrichiine plan but retains the free-living adaptations of the earlier instars; on the basis of this and the characteristic adult features this genus would appear to be a specialized and distinct member of the Leucotrichiini and is placed here in its own subgroup.

Tribe OCHROTRICHIINI trib. n.

Type-genus: *Ochrotrichia* Mosely, 1934.

DISTRIBUTION. North and Central America.

The tribe Ochrotrichiini is proposed here for the small group of Nearctic and Neotropical hydroptilids composed of *Ochrotrichia* (*O. Ochrotrichia* and *O. Metrichia*) and *Rhyacopsyche*. As will be discussed in more detail below, *Metrichia* was reduced to a subgenus of *Ochrotrichia* by Flint (1972a) on the larval affinities, Flint (1971) having previously indicated the relationships of the adults of *Metrichia* and *Rhyacopsyche*. The relationships of these genera have not been thoroughly investigated due to the lack of comparative material. Flint's views have therefore been accepted and, as the group exhibits a number of characteristic adult features which distinguish it from the other hydroptiline groups, it has been accorded the status of tribe. However, this arrangement is not entirely satisfactory and the group may subsequently prove to be a subgroup of the tribe Hydroptilini. This will be discussed in more detail in the discussion below.

DIAGNOSIS. *Adult.* Forewing length 1.5–3.5 mm: head and antennae unmodified (Fig. 93); tentorium complete; ocelli 3; postoccipital lobes small, subspherical: mesoscutellum with transverse suture (Fig. 93); metascutellum pentagonal or convexly subtriangular: spur formula 0.3.4 or 1.3.4: abdomen with typical hydroptiline setate processes of segment V: ♀ genitalia a simple oviscap: ♂ genitalia variable but basically with segment VIII unmodified and inferior appendages well developed and elongate.

Larva (Figs 97–99). General appearance typical of basic, unspecialized hydroptilid: head unmodified, labrum symmetrical: three pairs of thoracic nota, each divided by a distinct median line: abdomen distended, slightly compressed; abdominal tergites absent except on segment IX; anal prolegs fused to sides of segment X.

Case. Variable between genera: basic 'purse-type' hydroptilid case in *Ochrotrichia*, usually covered in fine sand grains; modified in *Rhyacopsyche* as an elongate, tubular case tapering at both ends and attached at one end to the substrate by a short silken thread.

Pupa. No description available, but probably of the typical hydroptiline form with long, untoothed mandibles.

DISCUSSION. The Ochrotrichiini is a distinct, warm-adapted, New World group of the subfamily Hydroptilinae. It may be distinguished from the Leucotrichiini, with which it shares the feature of a transverse mesoscutellar suture, by the characteristic and highly specialized male genitalia and the basic hydroptilid appearance of the larva. The tribe may later prove to be a subgroup of the Hydroptilini but is provisionally treated here as distinct on the basis of certain fundamental morphological and behavioural features. These include the presence of a transverse mesoscutellar suture and the characteristic male and female genitalia (including the absence of a spiral 'titillator' on the male aedeagus) and the associations of the larvae with running water habitats and their possible detritus-feeding habits (cf. the predominantly algal-feeding habits of the Hydroptilini). However, such features may be secondarily derived from the basic Hydroptilini condition, a thorough examination of representative adult and larval material being essential for the establishment of the true relationships of the group within the Hydroptilinae and of the genera with one another.

Genus *OCHROTRICHIA* Mosely

Ochrotrichia Mosely, 1934 : 162. Type-species: *Ochrotrichia insularis* Mosely, by original designation and monotypy.

DISTRIBUTION. North, Central and South America.

The genus *Ochrotrichia* has recently been reviewed by Denning & Blickle (1972) who list the 40 known species and give descriptions of 15 additional new species from the western United States and Mexico. In the same year Flint (1972a) published a paper on 'The genus *Ochrotrichia* from Mexico and Central America (Trichoptera : Hydroptilidae)' in which he described a number of new species and proposed *Metrichia* as a subgenus of *Ochrotrichia*, and *Rhyacopsyche* as a close, but distinct, relative. Flint (1968b) had already stated his views regarding the congenericity of *Metrichia* and *Ochrotrichia* but they were not accepted by Denning & Blickle (1972). As it has not been possible to investigate this question in detail due to the paucity of material in the BMNH collections, Flint's views have been accepted here. There is obviously a need for a thorough and critical review of the group to establish the relationships of the genera concerned and to investigate the position of the group within the Hydroptilinae.

DIAGNOSIS (*Ochrotrichia* sensu Flint, 1972a). *Adult*. Forewing length 1.5–3.0 mm: head unmodified; tentorium complete (Fig. 93); antennae simple (c. 33-segmented in *insularis*); mesoscutellum (Fig. 93) with transverse suture; metascutellum convexly subtriangular: spur formula 0.3.4 or 1.3.4: ♀ genitalia a simple oviscapit; internal surface of sternite VIII often sclerotized and reticulate in *Ochrotrichia* (*Metrichia* not described): ♂ genitalia distinct (Figs 94–96) with segment VIII unmodified; segment IX fused, annular, deeply incised dorsally; tergite X often highly developed with numerous spines and processes; inferior appendages usually strongly developed, basically broad and elongate, usually with various processes and rows of spines; aedeagus simple and thread-like (*Ochrotrichia*), sometimes armed with strong spines (*Metrichia*).

Larva (Fig. 97) after Flint (1972a). General appearance typically hydroptilid: head unmodified; mandibles robust, broadly subtriangular, medial brush in left only: meso- and metanota with pronounced antero-dorsal processes; prothorax with a pair of anal sternites (Fig. 44, after Wiggins, 1977); pleurites well developed (at least on prothorax): abdomen similar to that of *Hydroptila* (cf. Fig. 118) being slightly distended and laterally compressed; dorsal 'rings' present.

Case. Similar to that of *Hydroptila*; constructed of two laterally compressed silken valves, 'purse-type', covered in fine sand-grains and, occasionally, filamentous algae (Wiggins, 1977); sometimes the case consists of a single dorsal convex valve carried 'tortoise-shell' like, the ventral valve being flat and of secretion only.

Pupa. No description available.

BIOLOGY. The larvae occur in a wide variety of running water habitats (rivers to warm streams and cold springs) and temporary streams according to Ross (1944); the specimens with cases carried 'tortoise-shell' like were from a spring stream on rocks in a thin film of water; the feeding habits are unknown but it is possible that the larvae are detritus feeders.

Key to subgenera (adults) (adapted from Flint, 1972a)

- 1 Spur formula 0.3.4; ♂ inferior appendages and tergite X complex, aedeagus simple and thread-like **OCHROTRICHIA** (p. 186)
 – Spur formula 1.3.4; ♂ inferior appendages and tergite X simple, aedeagus with well-developed spines **METRICHIA** (p. 186)

Subgenus **OCHROTRICHIA** Mosely

Polytrichia Sibley, 1926 : 102. Type-species: *Ithytrichia confusa* Morton, by monotypy. [Preoccupied by *Polytrichia* Borg de St Vincent, 1831 in Protozoa.]

Ochrotrichia Mosely, 1934 : 162. Type-species: *Ochrotrichia insularis* Mosely, by original designation and monotypy. [Synonymized with *Polytrichia* by Mosely, 1937 and reinstated by Ross, 1944.]

This subgenus is distributed throughout the U.S.A., with a few species recorded from southern Canada, Panama and the Antilles, although the group appears to be predominant in the midwest and montane regions of the United States.

DIAGNOSIS. *Adult.* Spur formula 0.3.4; ♂ genitalia with inferior appendages and tergite X often very complex, aedeagus simple and thread-like.

The subgenus contains about 70 species which Flint (1972a) splits into two distinct groups (for the Central American species only). The *xena*-group is characterized by the male genitalia with its relatively simple segment IX and tergite X and the aedeagus, which varies from a simple tube to one which bears various processes (not as well developed as in *Metrichia*). It appears to be the simpler of the two groups with respect to the structure of the male genitalia and also seems to be intermediate between the next group and *Metrichia*. The group contains *xena*, *unio*, *flagellata*, *pectinata*, *brayi*, *caligula*, *marica*, *spinosissima* and *verda*.

The second group consists of all other Central American and Antillean species which Flint (1972a) further splits into six subgroups; the group is characterized by the fusion of tergites IX and X in the male genitalia to form a complex structure bearing many spines and plates (Fig. 95, terminology after Ross, 1941b), and also the very simple, thread-like aedeagus. A key to the males of the Central American species is given by Flint (1972a).

Larvae have been associated with the following species: *anisca*, *riesi*, *spinosa*, *tarsalis*, *unio* and *xena*, a key to which is given by Ross (1944). According to Flint (1972a), the larvae of this subgenus are found in running water, usually in small to moderately sized streams, sometimes in very shallow water and often in streams that dry up during the dry season. Flint also remarks that the adults come readily to light unlike those of *Metrichia*.

Subgenus **METRICHIA** Ross

Metrichia Ross, 1938 : 9. Type-species: *Orthotrichia nigrutta* Banks, by monotypy.

Argentitrichia Jacquemart, 1963 : 339. Type-species: *Argentitrichia bulbosa* Jacquemart, by monotypy.

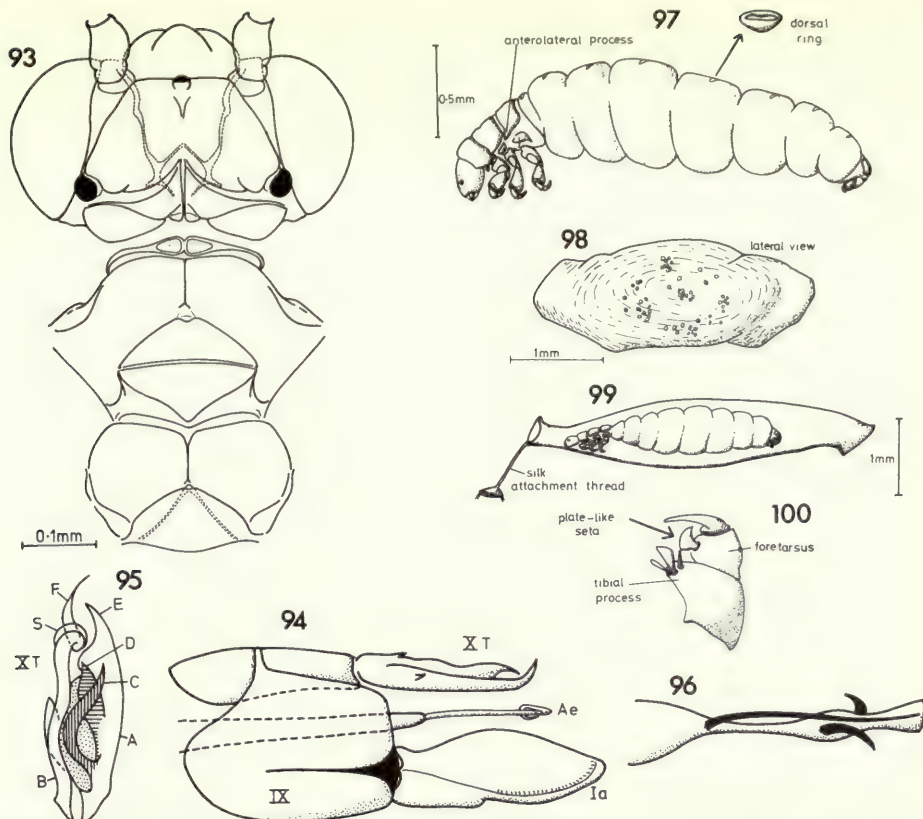
Syn. n.

This subgenus has a more southerly distribution than *Ochrotrichia*, occurring in the south-west United States, throughout Central America and the Antilles, Peru, north-west Argentina, central Chile and Surinam. According to Flint (1972a) the area of greatest diversity occurs throughout Central America and the Antilles.

DIAGNOSIS. *Adult.* Spur formula 1.3.4; ♂ inferior appendages and tergite X simple, aedeagus with well-developed spines; ♂ with internal abdominal sacs (between IV–V, V–VI or VI–VIII) and dorso-lateral hair brushes on abdominal segments V and VI.

There are 19 distinct species of which Flint (1972a) splits the Central American representatives into five groups on the basis of the presence and positioning of the internal abdominal sacs of the males, the dorso-lateral hair brushes and the structure of the aedeagus (Fig. 96). Flint also gives a key to the males of the Central American species.

Larvae have been associated with *nigrutta* by Edwards & Arnold (1961) and *juana* by Flint (1968a). According to Flint (1972a) the larvae build 'purse-type' cases of silk and organic particles. On the basis of features of the two known species, Flint concludes that the subgenus appears to



Figs 93–100 Ochrotrichiini. 93, adult head and thorax, dorsal view, *Ochrotrichia*. 94–96, generalized ♂ genitalia. 94–95, *Ochrotrichia* (*Ochrotrichia*); (94) lateral view; (95) tenth tergite, dorsal view (terminology after Ross, 1941b). 96, *O. (Metrichia)*, aedeagus, lateral view (vide Figs 15, 16). 97–98, *Ochrotrichia* (*O.*) *jauna* Flint; (97) larva, lateral view; (98) case, lateral view. 99–100, *Rhyacopsyche mexicana* (Flint); (99) larva in case, lateral view; (100) larval foretibio-tarsus, lateral view.

be closely associated with springs, seeps, waterfalls and the like (rather than the larger, relatively more slowly flowing streams preferred by *Ochrotrichia*). Flint also states that the adults are more frequently taken by sweeping vegetation than at light.

Flint (1972a), following Schmid (1958a), considers *Metrichia* to be most closely related to the Palearctic genus *Microptila* (sensu Schmid, vide the Hydroptilini, *Agraylea*-group) on the basis of the form of the male genitalia and wing venation. He also recognizes the possibility that *Microptila* may eventually come to be considered as a third subgenus of *Ochrotrichia*. As will be seen in the account of *Microptila*, *Metrichia* is really very dissimilar to and quite distantly related to *Microptila*. These conclusions were based on a comparative study of features of the head, thorax and male genitalia of the two groups.

Finally, *Argentitrichia bulbosa*, described by Jacquemart (1963) from the Argentine, appears to be a species of *Metrichia* according to the characteristic form of the male genitalia (material not examined).

Genus *RHYACOPSYCHE* Müller

Rhyacopsyche Müller, 1879a : 40. Type-species: *Rhyacopsyche hagenii* Müller, by subsequent monotypy. *Rhyacopsyche* Müller, 1879c : 143.

DISTRIBUTION. Central America.

Müller (1879a) erected *Rhyacopsyche* for a single Brazilian species, which he subsequently

(1879c) named *hagenii*, on the basis of the larval cases only. Figures and full descriptions of the larval and pupal cases were not published until 1880 by Müller, the first descriptions of the adults and larvae being given by Thienemann (1905). Möller (1921) subsequently reproduced a previously unpublished figure by Müller of the general appearance of the larva.

Following the discovery of immature and adult stages of *Metrichia mexicana* in Guatemala (first described from Mexico by Flint, 1967a), Flint (1971) considers this species to be congeneric with *Rhyacopsyche hagenii*. Consequently Flint (1971) described the genus *Rhyacopsyche* and gave a key to the males of *mexicana* and three new species.

DIAGNOSIS (after Flint, 1971). *Adult*. Forewing length 2.5–3.5 mm: head and antennae simple; ocelli 3: mesoscutellum with transverse suture (cf. Fig. 93); metascutellum pentagonal: spur formula 1.3.4: ♀ genitalia a simple oviscapt, tergite VIII with posterior lobes; ♂ genitalia with segment VIII unmodified; IX produced into dorso-lateral lobes; tergite X contracted inside lobes of IX; inferior appendages large and distinct, elongate and curved upwards; single, reduced, median subgenital sclerite; aedeagus with tubular basal half, apical half with central tube and thin spiral filament, apex with thickened spine.

Larva (Fig. 99). Typically hydroptilid with thoracic nota present on all three segments, divided medially; sternites apparently absent; legs short, subequal; apex of fore-tibia with a distinct process bearing several enlarged setae; tarsus short with one or two enlarged, plate-like setae (Fig. 100): abdomen distended, slightly compressed; tergites absent; anal prolegs fused to segment X.

Case (Fig. 99). Larval case elongate, tubular, tapering at both ends; silken, covered in sand grains (*mexicana*) or of secretion only (*hagenii*); attached to substrate by a long silken thread from the anterior end. Pupal case of *mexicana* apparently split along posterior end according to the figure in Flint (1971), but this may have been drawn after emergence of the pharate adult; pupal cases of both *mexicana* and *hagenii* anchored by a short silken stalk.

BIOLOGY. The larvae and pupae of *mexicana* were found on an exposed boulder subjected to constant wetting from spray and a thin film of water running down from a nearby cascade. The pupal cases were attached at right angles to the boulder on the moist, but not submerged, surfaces. According to Flint (1971) the larval cases of *mexicana*, unlike those of *hagenii*, are not attached by a thread to the substrate until just prior to pupation.

DISCUSSION. According to Flint (1971) the adults of *Rhyacopsyche* may be distinguished from those of *Metrichia* only by the form of the male and female genitalia (the lobes of segment IX and the relatively simple aedeagus of the male and the lobes of tergite VIII of the female in *Rhyacopsyche*). The larvae of *Rhyacopsyche* are, according to Flint (1971), very similar to those of *Ochrotrichia* s.l. and *Hydroptila*, being distinguished by the plate-like setae of the fore-tibia and the hook-like tarsal claws. The larval and pupal cases are, however, so far unique to *Rhyacopsyche* and are probably adapted to exposed conditions in fast-flowing water, being fusiform and anchored by a silk thread to the substrate.

The morphology of the larva has not been described in sufficient detail to allow a deeper investigation into the generic relationships of *Rhyacopsyche* but adult features suggest that the genus is closely allied to *Ochrotrichia* s.l. I do not agree with Schmid (1958a) and Flint (1971) that these genera are closely related to *Microptila* (q.v.).

Tribe NEOTRICHIINI Ross

Neotrichiini Ross, 1956 : 18. Type-genus: *Neotrichia* Morton, 1905.

DISTRIBUTION. Nearctic, Neotropical.

Ross first used the name Neotrichiini in a phylogenetic diagram (Ross, 1956 : 18, chart II) showing the coincidence of the primitive lines of Trichoptera with the 'cool-adapted habitat', the Neotrichiini representing a specialized 'warm-adapted' offshoot of the main Hydroptilini branch. Ross, however, did not then or subsequently define the tribe although he is still of the opinion that the group should be maintained as distinct from the rest of the Hydroptilidae, principally on account of the characteristic form of the larvae and their 'Limnephilid-like' cases (Ross, *in litt.*). Therefore, although Ross's (1956) classificatory scheme has been modified here in that the Hydroptilini sensu Ross are treated as a subfamily, the status of the Neotrichiini is retained as originally proposed.

The Neotrichiini consists of two exclusively warm-adapted New World genera, *Neotrichia* and *Mayatrichia*, the combined distribution of which extends from Canada, through the United States and Central America (the regions of greatest species and individual numbers) down into central Argentina. The genera share a number of unique adult and larval characters which distinguish them from all other Hydroptilinae, although they still retain the basic diagnostic features of this subfamily. As indicated above, the immature stages characterize the Neotrichiini since the larvae construct cylindrical cases, with circular anterior and posterior openings, reminiscent of the higher limnephiloid groups and quite unlike the basic 'purse-type' case of the Hydroptilidae. The larvae accordingly exhibit parallel limnephiloid-like morphological features associated with the form of the case. These include the cylindrical abdomen and the free anal prolegs which may be extended through the wide posterior opening of the case, and in one species of *Neotrichia* a lateral line appears to be present.

The following diagnosis is based on Ross (1944) and examination of adult material in the BMNH collection and larvae of both genera (USNM loan).

DIAGNOSIS. *Adult.* Forewing length 1.5–2.0 mm: head and antennae simple; tentorium complete; ocelli 3: mesoscutellum without transverse suture, anterior margin convex; metascutellum convexly subtriangular: fore-tibia without apical spur: abdomen with typical lateral setate processes on sternite V: ♀ genitalia a simple oviscapt: ♂ genitalia (Fig. 101) – segment VIII unmodified; IX fused, annular, open postero-ventrally, well-developed postero-lateral processes present; inferior appendages and subgenital plate well developed; bilobed process sometimes present and often may be fused to the underside of the subgenital plate in some species of *Neotrichia*; tergite X usually membranous with various lobes; subgenital appendages present (homologies uncertain).

Larva (Figs 102, 104–106). Head conical, tapering anteriorly, antennae relatively long (cf. other Hydroptilidae): thoracic nota paired: abdomen only slightly distended, cylindrical, abruptly enlarged from segment II, from there gradually tapering posteriorly; tergites VIII and IX present only, latter covering whole of dorsum; anal prolegs slender, long, projecting freely from segment X; lateral fringe of short setae ('lateral line') sometimes present along sides of abdomen: thoracic legs slender, tarsal claws long.

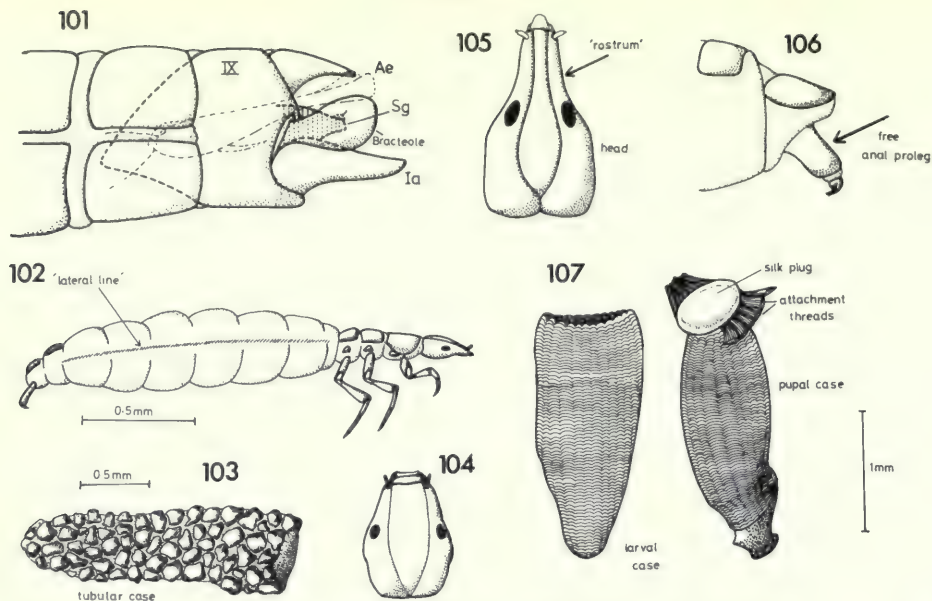
Case. Cylindrical, slightly tapering posteriorly, constructed of secretion only (surface strongly ridged) (Fig. 107) or with a covering of small sand-grains (Fig. 103); openings suboval to circular, wider anteriorly.

BIOLOGY. Larvae occur on rocks in rapid sections of rivers and streams; details of feeding habits unknown, but probably detritus-feeders; according to Wiggins (1977) the guts of three specimens of *Mayatrichia* contained almost exclusively fine organic particles although, from the shape of the head, he suspects them to have specialized feeding habits.

DISCUSSION. The Neotrichiini is exclusively a New World group containing two very closely related genera which are distinguished from each other by features of the male genitalia, adult spur formula and the general form of the larva. The structure of the adult thorax and presence of the spiral aedeagal process in the males of *Neotrichia* indicate that the group may have arisen relatively recently from the main Hydroptilini branch and evolved its characteristic features in isolation on the American continent. The most notable feature, apart from their minute size, is the distinctive appearance of the larvae which seem to have developed characteristics similar to those of the limnephiloid groups in association with the possession of cylindrical cases. As Ross (1956) points out, however, it is unlikely that the Neotrichiini gave rise to the limnephiloid branch of the Trichoptera since this tribe is a very specialized member of the Hydroptilinae, the superficial similarities having arisen by parallel evolution. In addition, the larvae do not seem to have the habit of feeding on filamentous green algae, as is characteristic of the Hydroptilini, and are supposed to be detritus-feeders. From the form of the larval mandibles, which are robust and not markedly dentate or asymmetrical, the detritus-feeding habit would appear to be a primary characteristic and not secondarily derived from the algal-feeding condition (cf. *Ithytrichia*). The position of the Neotrichiini within the Hydroptilidae will be discussed later.

Genus *NEOTRICHIA* Morton

Cyllene Chambers, 1873 : 124. Type-species: *Cyllene minutissimella* Chambers, by monotypy. [Preoccupied several times, *vide* Fischer, 1961.]



Figs 101–107 Neotrichiini. 101, ♂ genitalia, lateral view, *Neotrichia* (vide Figs 15, 16). 102–104, *Neotrichia* sp.; (102) larva, lateral view; (103) case, lateral view; (104) head, larva, dorsal view. 105–107, *Mayatrachia ayama* Mosely; (105) head, larva, dorsal view; (106) anal proleg, larva, lateral view; (107) larval and pupal cases, lateral views.

Neotrichia Morton, 1905 : 72. Type-species: *Neotrichia collata* Morton, by monotypy.

Exitrichia Mosely, 1937 : 170. Type-species: *Exitrichia anahua* Mosely, by original designation. [Synonymized by Ross, 1944.]

Dolotrichia Mosely, 1937 : 177. Type-species: *Dolotrichia canixa* Mosely, by original designation. [Synonymized by Ross, 1944.]

Guerrotrichia Mosely, 1937 : 179. Type-species: *Guerrotrichia caxima* Mosely, by original designation. [Synonymized by Ross, 1944.]

Lorotrichia Mosely, 1937 : 181. Type-species: *Lorotrichia hiaspa* Mosely, by original designation and monotypy. [Synonymized by Ross, 1944.]

DISTRIBUTION. Nearctic, Neotropical.

Neotrichia is exclusively a New World genus with representatives occurring most abundantly in the U.S.A. and Mexico, although a few species have been recorded from Canada, the Antilles Surinam and Brazil. There are 46 species which fall into a number of distinct groups which are characterized by features of the male genitalia and which correspond with the genera described by Mosely (1937) and subsequently synonymized by Ross (1944). The Surinamese species (Flint, 1974) appear to fall into two additional groups.

According to Ross (1944) the larvae of *minutissimella*, *okopa*, *collata* and *riegeli* are known but only those of the first named have been described. However, Flint (1964; 1968b; 1968c) has since described the larva of *iridescent*.

DIAGNOSIS. Adult. Spur formula 0.2.3: ♂ genitalia (Fig. 101) sometimes with ventral process on sternite VIII; segment IX annular, generally complete dorsally and ventrally; tergite X variable but usually forming a well-developed dorsal plate; inferior appendages distinct, somewhat elongate, usually with prominent, spatulate bracteole (*Br*); subgenital plate well developed with a pair of apico-ventral setate lobes (representing fused bilobed process ?); a pair of narrow subgenital appendages sometimes present ('slender structure' (Flint, 1964); 'filiform appendage' (Ross, 1941b)); aedeagus elongate, generally with a wide tubular base narrowing to a median constriction or neck from which arises a stout spiral process, apical half more slender, divided at apex or bearing apical spines.

Larva (Figs 102, 104). Head cone-shaped, tapering anteriorly; labrum symmetrical; mandibles sub-symmetrical, short, robust, not markedly dentate; thoracic nota covered in long sparse setae; legs long

and slender (cf. *Mayatrichia*): abdomen cylindrical but not as rotund as in *Mayatrichia*, intersegmental grooves distinct.

Case (Fig. 103). Cylindrical, tapering posteriorly, basically of silk and often covered in small sand-grains.

BIOLOGY. Larvae found in rapid sections of rivers and streams.

Genus *MAYATRICHIA* Mosely

Mayatrichia Mosely, 1937 : 182. Type-species: *Mayatrichia ayama* Mosely, by original designation.

DISTRIBUTION. Nearctic.

There are only four species in this genus which are all of local occurrence but have an overall distribution ranging from Saskatchewan to Mexico and from Ontario to Maine. Ross (1944 : 278) gives a key to the males of the three North American species (*ayama*, *ponta* and *acuna*) with *rualda* from Mexico being described by Mosely (1937 : 183). The larvae and cases of *ayama* (including an early instar) and *ponta* have been described by Ross (1944) and Wiggins (1977) respectively.

DIAGNOSIS. *Adult.* Spur formula 0.2.4: ♂ genitalia with sternite VI with a long, slender ventral process; segment IX annular, deeply incised along postero-ventral margin, accentuated by postero-lateral processes; tergite X membranous, hood-like; inferior appendages with broad, setae-bearing posterior margin and a small, digitate, dorso-lateral projection; subgenital plate well developed with postero-medial, ventrally directed processes and produced dorso-laterally to meet tergite X; bilobed process absent; aedeagus simple, long, apex filiform or with three 'staggered tubercles' (Ross, 1944).

Larva (Figs 105, 106). Head very attenuate anteriorly: thoracic nota covered in short, stout setae; legs relatively shorter and more robust than in *Neotrichia*: abdomen rotund, cylindrical, with faint intersegmental grooves; lateral setal fringe present only in *ayama*.

Case (Fig. 107). Cylindrical, tapering posteriorly, constructed of secretion only but with strengthening transverse or longitudinal ridges.

BIOLOGY. According to Wiggins (1977) the larvae occur on rocks in rapid sections of rivers and streams, generally in rather large bodies of running water.

Tribe **HYDROPTILINI** Stephens

Hydroptilidae Stephens, 1836 : 151. Type genus: *Hydroptila* Dalman, 1819.

DISTRIBUTION. Cosmopolitan (excluding polar regions).

The Hydroptilini, as interpreted here, contains the most widely distributed and successful contemporary genera of the subfamily Hydroptilinae. Although the tribe may appear to be very heterogeneous when considering the variety of both adult and larval morphological features, habits and habitat preferences, all members do have a number of basic affinities. These include features of the adult thorax and the male genitalia, and also the fundamental association of the larvae with green filamentous algae in more slowly moving bodies of water. Owing to the diversity of the group, however, it is difficult to give a precise diagnosis of the tribe. The following is only a preliminary attempt at a formal diagnosis of the tribe, since this must await further more detailed research into the possible relationships of the genera and the discovery of all the larval stages.

DIAGNOSIS. *Adult.* Forewing length 1.5–6.0 mm. Head basically unmodified (e.g. Fig. 108); antennae simple; ocelli 3 or 0; postoccipital lobes variable, modified in *Hydroptila* (♂) as 'scent caps'; tentorium variable, distinct or reduced; shape of thoracic nota variable (Figs 108, 139); mesoscutellum without transverse suture, diamond-shaped or with convex anterior edge; metascutellum pentagonal or with convex anterior edge; spur formula 0.2.3, 0.2.4, 0.3.4 or 1.3.4: lateral setate process of abdominal segment V present, pit sometimes sculptured: ♀ genitalia (Figs 17, 121) basically a simple telescopic oviscapt, sometimes fused and non-retractile: ♂ genitalia very variable with form characteristic for each genus (Figs 109, 115, 122), aedeagus usually with spiral 'titillator'.

Larva. The larvae of *Microptila*, *Dhatrichia*, *Stenoxethira* and *Xuthotrichia* have not yet been described. Basically of the typical hydroptilid 'purse-case' building form. Head unmodified, mouthparts usually showing various degrees of specialization associated with feeding on the cell contents of green filamentous algae; lateral line and gills absent, body often slightly compressed laterally, anal prolegs fused to sides of segment X, abdominal tergites usually absent, 'dorsal rings' present. The forms of the larva and its case

vary according to habits and habitat preferences. Substrate dwellers such as *Hydroptila* retain the generalized hydroptilid form and their 'purse-type' cases often incorporate sand-grains and diatoms, possibly to aid ballast. Larvae found amongst aquatic vegetation are usually characterized by their lighter cases, often of secretion only, and the elongation of the mid- and hindlegs. The recently described larva of *Ugandatrichia* is very specialized, being adapted for life in torrenticolous conditions. Many of its features parallel those of *Stactobia* and leucotrichiine larvae, for example, in that it is strongly dorso-ventrally flattened and heavily sclerotized, with well-developed abdominal tergites. *Ugandatrichia* is also unique in that the fifth instar larva does not build a case until just prior to pupation.

Pupa. Typically hydroptilid, mandibles long and without teeth.

DISCUSSION. The tribe Hydroptilini is considered here to consist of three subgroups which are distinguished by male and female genitalic characters and the general appearance and habits of the larvae. Within each subgroup the genera variously exhibit both generalized and specialized hydroptilid characteristics. The subgroups are defined below.

The *Agraylea*-group. This contains some of the larger and more generalized hydroptilids with respect to the overall appearance of the adults. The male genitalia, however, are rather distinctive and conform to a common basic pattern within the subgroup. The larvae of *Agraylea* are essentially adapted for life in vegetation thickets in slow-moving to static bodies of water, whereas those of *Ugandatrichia* are adapted for life in torrenticolous habitats and are free-living in the fifth instar.

The *Hydroptila*-group. This essentially consists of the nominate genus *Hydroptila* with which a number of genera have here been synonymized. The adults exhibit generalized but distinctive patterns of genitalia which vary slightly between species-groups; the larvae are basically typical of the hypothetical generalized hydroptilid but are adapted for feeding on filamentous algae on more or less exposed substrates in moderate to fast-flowing water. The genus is distinguished by the specialized cephalic (postoccipital) scent-caps of the males and the absence of ocelli in both sexes. *Hydroptila* contains the greatest number of species within the Hydroptilidae and has the widest geographical distribution; it therefore may be regarded as perhaps the most successful genus of the family.

The *Oxyethira*-group. This is a more heterogeneous group with regard to adult features, each genus possessing a very distinct set of genitalia, but it is characterized by the relatively uniform appearance of the larvae. The latter are specialized filamentous algal feeders and are generally associated with vegetation thickets in slowly moving to static bodies of water. Within the group there is a definite trend towards the elongation of the mid- and hindlegs in the larvae which reaches its extreme condition in *Tricholeiochiton fagesii*. *Oxyethira*, like *Hydroptila*, has a continuous world-wide distribution (although represented by fewer species) while *Stenoxyethira*, *Paroxyethira* and *Xuthotrichia* are restricted to SE. Asia, New Zealand and Australia respectively; *Tricholeiochiton* has one west Palaearctic and two SE. Asian representatives only.

Thus the Hydroptilini as interpreted here consists of three distinct and more or less specialized groups which have been united on the basis of the form of the male aedeagus and the basic associations of the larval stages with green filamentous algae. The three groups probably diverged relatively early in the evolution of the Hydroptilini branch although somewhat later than the Ochrotrichiini, Neotrichiini and Orthotrichiini split off from this main stem (*vide* Chart II). The hypothetical ancestral Hydroptilini larva probably differed little in appearance from that of the present-day generalized condition as seen, for example, in *Hydroptila*, with the slightly laterally compressed abdomen, subequal legs and simple 'purse-type' case. Such a condition is also seen in the unspecialized members of other groups such as the Ptilocolepinae, *Stactobiella*, *Ochrotrichia* and *Dibusa*. Within the Hydroptilini, however, the form of the larval case varies little from the generalized condition in *Agraylea*, *Allotrichia*, *Hydroptila*, *Tricholeiochiton*, *Paroxyethira* and perhaps *Xuthotrichia*, the only specialized genus in this respect being *Oxyethira* with its distinct 'jug-shaped' cases. The main differences in case-form appear to be associated with corresponding differences in larval morphology which reflect trends towards adaptation to life in vegetation thickets in slow-moving bodies of water. Thus the cases lose any extraneous particles which might weigh them down and the larvae tend to have longer mid- and hindlegs.

Within the *Agraylea*-group, *Agraylea* and *Allotrichia* have a temperate (to cool temperate)

distribution, *Dhatrichia* and *Microptila* are more subtropical (to temperate) while *Ugandatrachia* is tropical. *Hydroptila* and *Oxyethira* are cosmopolitan genera and occur throughout the Americas and through SE. Asia and Indonesia to the Australian region. The endemic Australian and New Zealand genera, *Xuthotrichia* and *Paroxyethira* respectively, probably represent descendants of an early branch of the *Oxyethira*-line which occurred in the Australian region but which was cut off from the mainland leaving the two genera to evolve in isolation ever since. *Tricholeiochiton* is distinguished by its rather unusual distribution pattern with one western Palaearctic species and two SE. Asian species. The origins of this genus are obscure but, from the general form of the larva, it may again have been derived from an early offshoot of the *Oxyethira*-line.

The success of the Hydroptilini (in terms of its present-day distribution and numbers) may be due partly to its larval associations with green filamentous algae and partly to its tolerance of a wider range of aquatic habitats in comparison with the more specialized Stactobiini and Leuco-trichiini and the more restricted Ochrotrichiini and Neotrichiini. The utilization of algal filaments (i.e. their cell fluid contents) may have opened the pathway from a life restricted to rocky and stony substrates, which is maintained to a certain extent in *Hydroptila*, to one in vegetation thickets. The latter may have at first been restricted to the banks of streams and larger, moderately flowing rivers but thence radiated into the more slowly moving waters of backwaters, lakes and ponds culminating in artificial, almost static, bodies of water such as reservoirs, etc. The distribution of vegetation-dwellers, or rather their dispersal, may also be enhanced by the accidental transport of the immature stages with the aquatic plants on which they dwell; here again the influence of man may play an important part in the success of these insects. *Hydroptila* shows great species variation as to habitat preference (as does *Oxyethira* to a certain extent); some, such as *forcipata* and *angulata* in Britain, favour the more stony fast-flowing streams of the north and west uplands while others, such as *sparsa* and *simulans*, occur more frequently in the slower and relatively more vegetated streams and canals of the lower regions.

Recent discovery of the larva of *Ugandatrachia* (Scott, 1976) indicates that this genus may have branched off from the Hydroptilini line at a very early stage in the evolution of the group, the larvae becoming specialized tropical members of the hydropetric fauna while the adults retained the generalized primitive form as seen also in *Agraylea*, for example.

In conclusion the Hydroptilini, although superficially seeming to be a somewhat heterogeneous tribe, can be seen to have a relatively recent point of origin along the main Hydroptilinae branch (although this was still geologically quite distant as indicated by the very modern looking fossil amber species of *Agraylea* and *Allotrichia*). The group has radiated out to fill a number of aquatic niches in association with green filamentous algae and larger and more slowly moving bodies of water. Early offshoots of the Hydroptilini-line may have given rise to the Ochrotrichiini and Neotrichiini in the Americas (and the unique, red-alga associated, Nearctic genus *Dibusa*) and the highly specialized Orthotrichiini (q.v.).

Genus *AGRAYLEA* Curtis

Agraylea Curtis, 1834 : 217. Type-species: *Agraylea sexmaculata* Curtis, by subsequent designation by Westwood, 1840.

Agraules Agassiz, 1846 : 32. [Unjustified emendation of *Agraylea* according to Fischer, 1961.]

Hydrorchestia Kolenati, 1848 : 103. Type-species: *Agraylea sexmaculata* Curtis, by subsequent designation by Kimmins, 1950. [Synonymized by Kimmins, 1950.]

DISTRIBUTION. Holarctic.

There are nine species in this small Holarctic genus although some of these are of doubtful status and are very restricted in occurrence. The most successful species are *sexmaculata*, which has a wide western Palaearctic distribution, and *multipunctata*, which is reputedly Holarctic but which probably involves a species complex. In my opinion the Nearctic form of *multipunctata*, as figured in Ross (1944), is distinct from the Palaearctic form (the type) in features of both the male and female genitalia (notably the relative size and shape of the inferior appendages and ventral process of sternite VII of the male) and should be referred to by its original designation (*signata* Banks). However, Ross (*in litt.*) has Alaskan material of what may prove to be a third species and he agrees that a thorough study should be made of all records previously referable to *multipunctata*.

from throughout the Holarctic region, including the records of the closely related European species, *cognatella*.

The following list summarizes the status of the species at present comprising the genus *Agraylea*.
A. spathifera Ulmer: Baltic Amber; closely related to *multipunctata*.

A. insularis Hagen: known only from a single female specimen (now lost) from Madeira which, according to Nybom (1948), was probably a female of *Stactobia atra* (Hagen).

A. drosima Navás: Navás (1917) gives only a crude description and figure of this subsequently unrecorded species from Spain; its identity remains doubtful until the type-specimen can be located.

A. argyricola Kolenati: originally described from Sweden and subsequently from Finland, this species has been regarded of doubtful identity ever since Eaton (1873) considered it to be a possible synonym of *multipunctata*; Nybom (1960) regards it as an 'unintelligible species' and has withdrawn it from the Finnish list.

A. multipunctata Curtis: possibly represented by a species complex (see above) consisting of *multipunctata* Curtis (Palearctic) and *multipunctata* Curtis sensu Morton (1905) (Nearctic) (= *signata* Banks ?).

A. sexmaculata Curtis: a distinct Palearctic species.

A. cognatella McLachlan: in this species the abdomen of the type-specimen, which has been crudely figured by McLachlan (1880), has been lost; however, it appears to be most closely related to *multipunctata*; the larva has been described by Solem (1972), although he had no spare adult specimens available for examination.

A. saltesea Ross: Nearctic (Montana, California); according to Ross (1944) this bears most resemblance to *multipunctata*.

A. costello Ross: Nearctic (Ontario, Maine); Ross (1941a) considers this to be most closely related to *Allotrichia pallicornis* (Eaton) (q.v.).

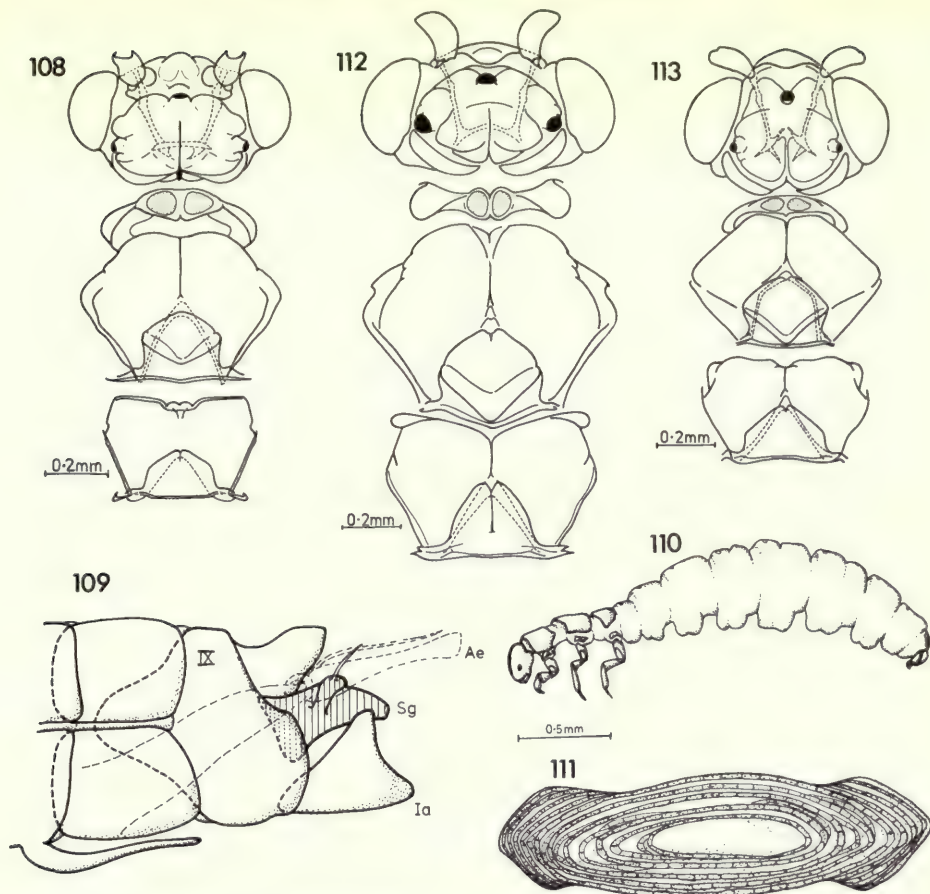
The larvae of the following species have been described: *multipunctata* (Nielsen, 1948; Lepneva, 1964; Hickin, 1967); *sexmaculata* (Lepneva, 1964; Barnard, 1971) and *cognatella* (Solem, 1972).

Agraylea is most closely allied morphologically to *Allotrichia* from which it was originally distinguished by the presence of fork 1 (R_2 and R_3) in the hindwing of *Agraylea*. This has not proved to be a consistent generic feature and the genera may later be found to be synonymous. They have been treated separately in this account, however, because the male genitalia of the *Allotrichia*-group of species conform to a distinct pattern (which may, nevertheless, be derived from the basic *Agraylea* plan). Also, the form of the male genitalia appears to link *Agraylea* with *Ugandatrichia* (and *Moselyella*) and *Dhatrichia*, the relationships of which will be discussed later.

The following diagnosis is based on specific descriptions and examination of adult and larval material in the BMNH collections. The general morphological features, apart from those of the genitalia, also apply to *Allotrichia*.

DIAGNOSIS. *Adult.* Forewing length 4–5 mm; wings (Fig. 7) relatively broad, apices slightly tapered, venation fairly complete (cf. Figs 5 and 8): head (Fig. 108) and antennae simple; ocelli 3; postoccipital lobes unmodified; tentorium distinct; mesoscutellum (Fig. 108) narrow, diamond-shaped; metascutellum narrow, pentagonal, parallel-sided; spur formula 0.3.4: lateral setate processes of abdominal segment V present, typical: ♀ genitalia a simple oviscap: ♂ genitalia (Fig. 109) generally with a long ventral process on segment VIII; segment IX forming an annulus, usually with a deep dorso-anal indentation; tergite X reduced to a short membranous lobe; inferior appendages generally well developed; subgenital plate triangular, tapering posteriorly (ventral view) and with a median, ventrally projecting process; aedeagus relatively short and stout with distinct proximal and distal halves, proximal broad ejaculatory duct giving rise to the slender distal intromittent organ from which arises the spiral 'titillator' (midway between the end of the ejaculatory duct and the constriction at the base of the intromittent organ).

Larva (Fig. 110). Body slightly compressed laterally: dorsal ecdysial lines of head indistinct; labrum symmetrical, short and broad with convex sides, concave anterior margin and small, antero-lateral projections; mandibles asymmetrical, robust (left with apical tooth and projecting dorsal blade without teeth but with small apical denticles, median brush present; right mandible without teeth which are replaced distally by two tubercles, inner median margin with central membranous bladder-like structure); 'postmental sclerites' entire in *multipunctata*, paired in *sexmaculata* (Figs 22, 21); posterior ventral apotome absent: legs short, subequal; fore-femur short and broad, baso-ventrally produced into a short



Figs 108–113 Hydroptilini, *Agraylea*-group. 108, 112, 113, head and thorax, dorsal view; (108) *Agraylea*; (112) *Ugandatrichia* (*Moselyella*); (113) *Ugandatrichia* s.str. 109, generalized ♂ genitalia, lateral view, *Allotrichia* (vide Figs 15, 16). 110–111, *Agraylea* sp., lateral view; (110) larva; (111) case.

process with apico-ventral projection of trochanter; distal process of tibia with typical spinose setae; small oral sternite present on prothorax only (Fig. 40); abdominal segment I larger than metathorax, abdomen widest at segment IV, intersegmental constrictions deep; dorsal 'rings' present on segments II–VIII; tergite present on segment IX; anal prolegs fused to X, anal claws relatively longer than in other hydroptilids. The early instars are described by Nielsen (1948).

The larvae of *multipunctata*, *sexmaculata* and *cognatella* can be distinguished by the markings of the dorsal head capsule (Solem, 1972).

Case (Fig. 111). 'Purse-type', constructed of silk and filaments of algae. The case building behaviour of *multipunctata* is described by Nielsen (1948).

Pupa. Typically hydroptilid, mandibles long, without median teeth; case a sealed larval case attached at each corner by a short silken pad to the surrounding vegetation.

BIOLOGY. The larvae of *Agraylea* occur in plant thickets in lakes and slowly flowing rivers in association with green filamentous algae. The larvae of *multipunctata* and *sexmaculata* have been observed to feed (Nielsen, 1948; Barnard, 1971) by grasping each algal filament with their modified chelate forelegs and passing it upwards between the mandibles with which they bite into each cell; the cell contents are then sucked out through this excision. According to Wiggins (1977) gut contents of *multipunctata* (Nearctic) included diatoms while Siltala (1907) records *Fucus*, algae and diatoms from the guts of Palearctic specimens of this species.

Genus *ALLOTRICHIA* McLachlan

Allotrichia McLachlan, 1880 : 508. Type-species: *Agraylea pallicornis* Eaton, by monotypy.

DISTRIBUTION. Palaearctic (including N. Africa).

This genus was erected for a single male specimen of what McLachlan regarded as a new species from Worcester, England but, just prior to publication, he discovered that it was identical to *Agraylea pallicornis* Eaton which thus became the type-species. McLachlan regarded the genus as distinct from *Agraylea* on the basis of the absence of fork 1 (R_2 and R_3) (vide Fig. 7, arrowed) in the hindwing. As pointed out previously, this has not proved to be a constant diagnostic feature and the genera may later come to be regarded as synonyms. *Allotrichia* is retained here, however, as the male genitalia of the constituent species conform to a characteristic pattern and the female genitalia and larval habits of *pallicornis* are distinct from those of *Agraylea* (although it is not certain whether *pallicornis* is typical of the *Allotrichia* group in general).

Apart from *pallicornis*, which has a widespread western Palaearctic distribution, the other members of this genus are all very local in occurrence; the following list summarizes the distribution and status of the species of *Allotrichia*.

A. ampullata Ulmer: Baltic Amber.

A. succinica Hagen: Baltic Amber.

A. heterocera Navás: based on a single female specimen from Spain with a vague description accompanied by a very nondescript figure and said by Navás to 'resemble *pallicornis*'; this species is therefore unrecognizable and must await the discovery and examination of the type.

A. pallicornis (Eaton): central and southern Europe, Algeria, Iran.

A. vilnensis Raciecka: refigured by Schmid (1959a) and known from the type-specimen from Poland and further material from Iran (Schmid); this species is distinct but very closely related to *pallicornis*.

A. tauri Jacquemart: described from a single male specimen from Turkey; it may prove to be synonymous with *pallicornis*.

A. teldanica Botosaneanu: a distinct species from Israel, closely related to *vilnensis*.

A. laerma Malicky: a distinct species from Greece.

[*A. africana* Marlier & Vaillant: I believe this species from the Congo to belong to the genus *Ugandatrichia* and to be closely related to, if not synonymous with, *U. nigra* Mosely (q.v.).]

The members of the genus *Allotrichia* are morphologically very similar to those of *Agraylea* and the adult generic diagnosis given for the latter, excluding the male and female genitalia, also applies to *Allotrichia* and therefore has not been repeated here. New species are allocated to either genus not according to the fusion of R_2 and R_3 in the hindwings, as was previously the practice, but by the general form of the male genitalia. However, Ross (1941a) states that the genitalia of *Agraylea costello* Ross are more like those of *Allotrichia pallicornis*, thus implying that the two genera are synonymous. Before any definite conclusions can be drawn, however, a thorough study of the *Agraylea*-*Allotrichia* complex needs to be carried out, incorporating as many male, female and larval features as possible; only the larva of *pallicornis* has so far been described (Giudicelli & Vaillant, 1967).

The following accounts of the male and female genitalia and the immature stages are based on original descriptions and examination of adult material of *pallicornis* in the BMNH collections.

DIAGNOSIS (see also *Agraylea*). *Adult*. ♀ genitalia an oviscapt; segment VIII without a ventral sclerite but with a characteristic asymmetrical groove. ♂ genitalia (Fig. 109) with concave inferior appendages, broad with concave posterior margins; the subgenital plate bears a pair of characteristic asymmetrical dorsal processes.

Larva (cf. Fig. 110) (after Giudicelli & Vaillant, 1967). Characterized by the lightness of the pigmentation of the sclerites and absence of dorsal markings (cf. *Agraylea*): setae of head and labrum much shorter than in *Agraylea*; dorsal ecdysial lines of head appear to be more distinct than in *Agraylea*; mandibles similar to those of *Agraylea* although the apices are more dentate; foreleg with distinctive chelate form but devoid of the specialized distal process of the tibia: abdominal tergites absent, including tergite IX (unusual); anal prolegs simple, claws apparently short.

Case. Identical with that of *Agraylea* (cf. Fig. 111).

Pupa. Typical; mandibles long with fine serrations along inner edge; case similar to that of larva but sealed, with two attachment pedicels (cf. four in *Agraylea*) at either end of one long side by which the case is held vertical to the substrate.

BIOLOGY. The immature stages were found in a rapid stream at 750 m with little shelter or marginal vegetation. Larval gut contents revealed, according to Giudicelli & Vaillant (1967), that the larvae are secondary substrate feeders which have been derived from the basic filamentous algal-feeding *Agraylea* stock; they have retained certain features associated with algal-feeding such as the asymmetrical mandibles, chelate forelegs, lateral flattening of the body and case and the incorporation of algal filaments into the latter.

The larvae of *Allotrichia pallicornis* thus differ from those of the known species of *Agraylea* in the lack of pigmentation, absence of abdominal tergite IX, simplicity of the anal prolegs, shorter head and labral setae, dentate mandibles and the attachment of the pupal case by two (cf. four) adhesive discs. These differences are apparently due to structural adaptations to living in fast-flowing water conditions and detritivorous feeding habits. As only the larva of *pallicornis* has so far been described, it is not known whether these features are diagnostic of *Allotrichia* species in general.

Genus *MICROPTILA* Ris

Microptila Ris, 1897 : 416. Type-species: *Microptila minutissima* Ris, by monotypy.

DISTRIBUTION. W. Palaearctic.

Microptila was erected for a new Swiss species, *minutissima* and *bejela* Mosely was subsequently described from Southern Yemen (Aden). Schmid (1960), as a result of studies on the trichopterous fauna of Sri Lanka and Pakistan, synonymized the African genus *Ugandatrichia* Mosely and the SE. Asian genus *Moselyella* Kimmins with *Microptila* on the basis of features of the wing venation and the general form of the male genitalia. Schmid described a number of new species, mainly from Pakistan and adjacent areas, which he considered to exhibit male genitalic features intermediate between those of the *Ugandatrichia*-*Moselyella* complex, which contains some of the largest known hydroptilids, and *Microptila*, which contains some of the smallest.

I have examined type-material of all three genera (BMNH collections) (including paratypes of three species described by Schmid (1960) and placed in *Microptila* sensu Schmid) but only one specimen of the type-species, *minutissima*, of *Microptila* was available for study. This is mounted in Canada Balsam and is now in a very poor condition, the features of the genitalia (male) being indistinct and the thorax completely destroyed thus rendering a comparative study impossible. Nevertheless, *Ugandatrichia* and *Moselyella* are considered to be distinct from *Microptila* s.str., the two former genera comprising a distinct group which has more affinities, at least in the adult stages, with *Agraylea* and *Allotrichia*, whereas *Microptila* s.str. bears more resemblance to *Dhatrichia* Mosely. This raises the problem of the correct generic identity of the species described by Schmid as *Microptila* s.l., which will be dealt with below.

On the basis of adult features alone, I propose to reinstate the genus *Ugandatrichia*, with *Moselyella* as a junior synonym, and to interpret *Microptila* in its original sense. These views may need to be modified with the discovery of new species and the larval stages, which have so far been described only for *Ugandatrichia*.

DIAGNOSIS. *Adult*. Forewing length 1.5–3.0 mm; antennae 20- to 25-segmented; ocelli 3: mesoscutellum short, anterior margin convex; metascutellum trapezoidal: spur formula 0.3.4: ♀ genitalia an ovicapt: ♂ genitalia simple; segment IX large, fused, with a shallow excision along dorso-posterior margin; tergite X forming a short membranous dorsal lobe; subgenital appendages elongate, slender, apparently arising lateral to tergite X; inferior appendages elongate, apices slightly incurved; subgenital plate elongate, semi-tubular; aedeagus simple, long and slender, tapering to a pointed apex in *bejela* (vide Mosely, 1948) and with a short spiral 'titillator' in *indra* and *apsara*.

M. indra is retained in this genus on the basis of the form of the thoracic nota; *apsara* is only doubtfully retained.

Genus *UGANDATRICHIA* Mosely gen. rev.

Ugandatrichia Mosely, 1939b : 36. Type-species: *Ugandatrichia minor* Mosely, by original designation. *Moselyella* Kimmins, 1951 : 195. Type-species: *Ithytrichia violacea* Morton, by original designation and monotypy. [Synonymized by Schmid, 1960.]

DISTRIBUTION. Africa (Congo, Uganda, Kenya, Zimbabwe); S. and SE. Asia (Burma, Assam, Pakistan, Sri Lanka, Sarawak).

Ugandatrichia is a small genus (10 species) of large, primitive-looking tropical hydroptilids. Schmid (1960) synonymized the then distinct genera *Ugandatrichia* and *Moselyella* with the Palaearctic genus *Microptila* but, for the reasons set out in the discussion below, *Ugandatrichia* (including *Moselyella*) has here been reinstated.

The following diagnoses are based on examination of adult material in the BMNH collections and on Scott's (1976) descriptions of the adults, pupae and larvae of *rhodesiensis*.

DIAGNOSIS. *Adult*. Forewing length variable, 2–6 mm; wings relatively broad but still long and acuminate as typical of the Hydroptilinae; forewings with dense setal covering (dark) with an oval patch of creamy scale-like hairs arising centrally from the membrane in *cyanotrichia* (Kimmins) (Fig. 6): tentorium complete (Figs 112, 113); antennae usually long (32–37 segments); ocelli 3: mesoscutellum diamond-shaped (Figs 112, 113) as in *Agraylea* (Fig. 108); metascutellum 'convexly subtriangular', narrow: spur formula 0.3.4: *violacea*, *cyanotrichia* and *nikitaruwa* (Schmid) each has a pair of long, membranous extrusible processes arising laterally between the tergite and sternite of segment II in the male: ♀ genitalia an oviscap; sternite VII with diagnostic patch or row of setae in certain species; sternite VIII with process or some other distinctive marking: ♂ genitalia with segment IX well developed, variously with dorsal and ventral posterior and anterior excisions; tergite X a median lobe with well-developed elongate lateral processes; inferior appendages large, broad and elongate; subgenital plate trilobed (or emarginate); aedeagus with distinct proximal and distal regions, divided by a constriction adjacent to which arises a short, spiral 'titillator'.

The thoraces of *nikitaruwa* (Schmid) and *sourya* (Schmid) are almost identical to that of *Ugandatrichia* (as seen in species of *Moselyella*), while *roudra* (Schmid) is included here on the basis of size and male genitalic affinities with *Ugandatrichia* species as noted by Schmid (1960). *M. apsara* Schmid may also belong here (see *Microptila* s.str. section).

Larva. The larva of *U. rhodesiensis* Scott has recently been described by Scott (1976) from which the following description of the immature stages and biology has been taken (for figures see Scott, 1976).

Fifth instar free-living, robust and heavily sclerotized, flattened dorso-ventrally: head relatively small, oval, tapering anteriorly; eyes large, distinct; ecdysial lines distinct; antennae well developed; anterior and posterior ventral apotomes small, former very narrow with long, slender anterior arms; labrum well developed, rectanguloid with convex sides, convex anterior margin and dense setal brushes arising postero-ventrally and projecting beyond anterior margin; mandibles almost symmetrical, apices blunt with no lateral teeth, left with dense inner brush of predominantly feathered spines ('penicillus'), right ridged externally and with long inner feathered spine and tuft of shorter bifid spines: all three thoracic nota paired; pleurites with preepisternite, episternite and epimeron; sterna entirely membranous and strongly muscular; legs short, stout and serving as powerful clinging appendages: abdomen dorso-ventrally flattened, gills absent; well-sclerotized tergites present dorsally on all segments, each with clear central spot on segments I–VIII; tergite IX with emarginate posterior margin; all segments distinctly demarcated and strongly muscular, ventral surfaces of segments II–VIII each with a pair of suckers close to lateral margins (adaptation for clinging to rocks); anal prolegs short, stout, fused to X and with simple large, hooked anal claws.

The larval stages are free-living throughout, a case being built only at the end of the final instar in which the latter pupates.

Pupa. Typically hydroptilid. Pupal case sac-like, tubular but not flattened and anchored by a holdfast at one end; case of tough, semi-transparent, parchment-like secretion.

BIOLOGY. The larvae and pupae of *rhodesiensis* were collected mainly from the most torrential parts of the waterfall on the Bundi River in Rhodesia. The larvae are clearly adapted for living in such harsh hydropetric conditions as indicated by their strongly sclerotized, robust, dorso-ventrally flattened form, clinging appendages and loss of the case building habit in the final instar. The form of the labrum and mandibles suggests that the larvae are substrate feeders.

DISCUSSION. According to the basic form of the male genitalia and the structure of the thoracic nota, especially with regard to the characteristic diamond-shaped mesoscutellum, I consider

Ugandatrichia and *Moselyella* to be synonymous and closely related to *Agraylea* as apposed to *Microptila* in which the mesoscutellum is more 'kite-shaped' with a convex anterior margin. Only specimens of *nikitaruwa* (Schmid), *sourya* (Schmid) and *indra* Schmid were available for study (BMNH collection, paratypes) and, from their thoracic features, the last mentioned would appear to belong to *Microptila* s.str. while the other two strongly resemble *Ugandatrichia* species. The affinities of *apsara* (Schmid) and *roudra* (Schmid) are still doubtful.

Thoracic structure alone, however, cannot be used as an indication of generic affinity. As Schmid (1960) rightly states, the genitalia of the *Microptila*-*Ugandatrichia*-*Moselyella* complex do have a common basic form but this is very generalized and has certain features in common with the genitalia of *Agraylea*, *Allotrichia* and *Dhatrichia*. Indeed, *Allotrichia africana* Marlier & Jacquemart appears to belong to *Ugandatrichia* and is very close to, if not synonymous with, *U. nigra* Mosely. Contrary to Schmid (1960), it is unlikely that there is any relationship between *Microptila* s.l. and the Nearctic-Neotropical subgenus *Ochrotrichia* (*Metrichia*) since the genitalia of the two groups are quite distinct and the characteristic mesoscutellar suture of *Ochrotrichia* is absent in *Microptila*.

Due to the recent description of the immature stages of *rhodesiensis* by Scott (1976), I have been able to include the following remarks concerning the affinities of the larvae with those of other hydroptilid genera. As Scott notes, the only other hydroptilid genus to retain the free-living habit throughout its larval existence is the Central American genus *Alisotrichia*. The larvae appear to have developed parallel structural adaptations suiting them for life in torrenticolous conditions but, as can be seen from a comparison of basic larval and, especially, adult features, the genera are totally unrelated, any affinities being purely superficial. *Alisotrichia* is a distinct, though rather isolated, member of the exclusively New World Leucotrichiini whereas *Ugandatrichia* would appear to be a distinct Palaeotropical component of the Hydroptilini.

The structural modifications of *Ugandatrichia* larvae are also paralleled to some extent by those of *Stactobia*, which are also heavily sclerotized, dorso-ventrally flattened with robust clinging appendages and similar madicolous habits. Fundamental differences can be seen, for example, in the fusion of the ecdysial lines of the head, the crenellated posterior margin of tergite IX and the retention of a case in the final instar of *Stactobia*. Comparison of the adult stages will immediately discount any close affinity between the two genera. It is interesting to note here that *Ugandatrichia* is essentially Palaeotropical whereas *Stactobia* is principally Palaearctic.

The discovery of the larva of *Ugandatrichia* does not, unfortunately, shed any light on its true generic affinities as may have been hoped since, as has been emphasized throughout this account, it is highly specialized and possesses structural modifications which tend to mask fundamental characters. It is, however, still possible that *Ugandatrichia* may be a descendant of an early ancestor of the Hydroptilini line which spread throughout the Palaeotropical regions, the larvae becoming specialized while the adults retained the primitive generalized form similar to that seen in *Agraylea* for example.

It would now seem essential to discover the immature stages of the SE. Asian *Moselyella* group of *Ugandatrichia*, as well as those of the Palaearctic *Microptila* group to establish the true affinities of this generic complex, since basic larval forms seem to serve as useful generic indicators in the Hydroptilidae.

A single specimen (♂) of *Ugandatrichia* (*Moselyella* group) has recently been collected from Sarawak, 1978 (*J. E. Marshall*), BMNH coll.

Genus *DHATRICHIA* Mosely

Dhatrichia Mosely, 1948 : 78. Type-species: *Dhatrichia inasa* Mosely, by original designation and monotypy.

DISTRIBUTION. Yemen, Zaire.

This small genus was first described for a single male specimen from the Yemen which is now mounted as a microscope slide preparation in the BMNH collection. A new species from Zaire, *bipunctata*, has been described by Statzner (1977), paratypes of which have been donated to the BMNH. The immature stages are unknown.

The following generic diagnosis is based on examination of the above material.

DIAGNOSIS. *Adult.* Forewing length 2 mm; wings narrow, tapering: tentorium complete but very fine medially; ocelli 3; antennae 19-segmented (male *inasa*); postoccipital lobes ovoid: mesoscutellum with convex anterior margin; metascutellum pentagonal, sides convergent anteriorly; spur formula 0.3.4: typical lateral setate processes of abdominal segment V present: ♀ genitalia an oviscapt: ♂ genitalia with segment IX annular, dorsally reduced to a narrow chitinated band and with well-developed postero-lateral sides (almost concealing genitalia in lateral view); tergite X ('upper penis cover' (Mosely, 1948)) broad, bilobed in *inasa*; inferior appendages short, apically broad, trilobed in *inasa*; subgenital plate an elongate flat process with a pair of apical setae and not extending beyond the sides of IX; aedeagus with a broad proximal ejaculatory duct and slender distal intromittent organ and with a spiral 'titillator' arising mid-length adjacent to the median constriction.

DISCUSSION. From the structure of the male aedeagus and the thoracic nota, *Dhatrichia* would appear to be a member of the Hydroptilini. The form of the male genitalia indicates an affinity with *Agraylea*, especially in the shape of segment IX and the form of the aedeagus; however, the thorax bears more resemblance to that of *Microptila* s.str. and these two genera (i.e. *Microptila* and *Dhatrichia*) can be separated in the generic key only by the form of the male genitalia.

Genus *HYDROPTILA* Dalman

Hydroptila Dalman, 1819 : 125. Type-species: *Hydroptila tineoides* Dalman, by monotypy.

Phrixocoma Eaton, 1873 : 132. Type-species: *Hydroptila sparsa* Curtis, by original designation. [Synonymized by McLachlan, 1880.]

Hydropneuma Enderlein, 1929 : 232. Type-species: *Hydropneuma juba* Enderlein, by original designation and monotypy. [Synonymized by Nybom, 1963.]

Hydroptilina Martynov, 1934 : 144. Type-species: *Hydroptilina angustipennis* Martynov, by monotypy. [Synonymized by Fischer, 1971.]

Oxydroptila Martynov, 1935 : 114. Type-species: *Oxydroptila furcata* Martynov, by original designation and monotypy. **Syn. n.**

Oeceotrichia Ulmer, 1951 : 85. Type-species: *Oeceotrichia elongata* Ulmer, by original designation and monotypy. **Syn. n.**

Pasirotichia Ulmer, 1951 : 90. Type-species: *Pasirotichia crenata* Ulmer, by original designation and monotypy. **Syn. n.**

Sumatranotrichia Ulmer, 1951 : 87. Type-species: *Sumatranotrichia trullata* Ulmer, by original designation and monotypy. **Syn. n.**

DISTRIBUTION. Cosmopolitan (excluding polar regions).

Hydroptila is the most successful genus of the Hydroptilidae with over 150 species and with an almost world-wide distribution; species have been recorded from Lapland and the northern U.S.S.R. to South Africa and Australia (including Tasmania) in the 'Old World' and throughout the Americas as far south as Nova Teutonia in Brazil. A number of geographically more or less distinct species-groups may be recognized by the forms of the male and female genitalia, and may eventually come to be considered as distinct subgenera. However, the species all have the following features in common: basic genitalia patterns; thoracic nota; absence of ocelli and presence of male dorsal postoccipital scent-organs in the adults, and the general appearance of the larvae and their cases. The immature stages are difficult to identify at the species level; Ross (1944) gives head and thoracic pigmentation patterns as rough guides to the identity of some Nearctic species although these tend to be very variable intraspecifically. My own observations indicate the possible use of features of the sculpturing and shape of the mandibles as specific guides but a full investigation was not carried out. The only satisfactory means of identification is by association with correctly identified pupae and adults.

There is no single comprehensive work on the genus as a whole, any one species-group or any particular faunal group, nor is there a key to the species of *Hydroptila*, identification at present relying on faunal keys (of which there are few) and reference to original descriptions, some of which are unsatisfactory and in need of redefinition. A species key was beyond the scope of this project but I have attempted to indicate the main species-groups, these groupings being based on affinities suggested by the original authors and, in many instances, by my own observations.

DIAGNOSIS. *Adult* (Fig. 1). Forewing length 3–4 mm: head (Fig. 114) with tentorium reduced medially; ocelli 0; antennae c. 30-segmented: mesoscutellum (Fig. 114) subtriangular with convex anterior margin; metascutellum pentagonal to triangular, anterior margin strongly convex: spur formula 0.2.4: setate processes present on abdominal segment V: ♀ genitalia a simple oviscap (Fig. 17); sternite VIII ('ventral plate', *vp*) and small sternite/s on IX ('dorsal plate/s', *dp*) sometimes present: ♂ genitalia (Figs 115–117) distinctive for each species-group but basically as follows – sternite VII often with ventral process; segment VIII rarely with ventral process; segment IX fused, annular, sometimes with antero-lateral apodemes (Fig. 117) and often with postero-lateral processes; inferior appendages distinct, usually simple, straight and elongate, sometimes modified (Fig. 117); tergite X forming a variable 'dorsal plate'; subgenital appendages variable (= 'parameres', 'lateral penis sheaths', 'intermediate appendages'); subgenital plate simple, broad, slightly emarginate in the *sparsa*- and *consimilis*-groups but absent or inconspicuous in others; bilobed process apparently absent (but may be incorporated into subgenital plate); aedeagus with distinct proximal and distal ejaculatory duct and intromittent organ respectively and a well developed spiral 'titillator'.

Larva (Fig. 118). The following species have been described (* indicates material examined in BMNH collections): *H. acuta* (Jacquemart & Coineau, 1962); *ajax*, *albicornis*, *angusta*, *armata* (Ross, 1944); *capensis* (Barnard, 1934); *consimilis* (Ross, 1944); *delineata* (Sibley, 1926); *emarginata* (Lepneva, 1932); *forcipata** (Fahy, 1972); *grandiosa*, *hamata* (Ross, 1944); *martorelli* (Flint, 1964); *pulchricornis* (Lepneva, 1964); *sparsa** (Hanna, 1961; Lepneva, 1964; Hickin, 1967); *spatulata* (Ross, 1944); *taurica* (Botosaneanu & Sykora, 1963); *tineoides** (Nielsen, 1948; Lepneva, 1964; Hickin, 1967); *trilobata* (Jacquemart, 1965); *vectis** (Jacquemart & Coineau, 1962; Lepneva, 1964); *waubesiana* (Ross, 1944).

Head elongate with almost parallel sides, almost circular in cross-section; ecydial lines indistinct; 'postmental' sclerites (Fig. 26) fused, although a faint median line may sometimes be detected, crescentic, without posterior process (cf. *Agraylea*); labrum long, anterior margin deeply indented, lateral lobes slightly asymmetrical, row of setae anteriorly; mandibles asymmetrical (Fig. 31), form variable between species, median brush in left only: thoracic pleurites as in *Agraylea* (cf. Fig. 35) but with preepisternite free on prothorax only; single oral and paired anal sternites on prothorax only (Fig. 39); legs short, subequal (Fig. 33) with distal ventral process of fore-tibia well developed and armed with specialized setae (Fig. 47) as in *Agraylea*: abdomen typically distended; dorsal 'rings' present on segments I–VIII; tergites absent except on IX; anal prolegs fused to X; three filamentous caudal gills present (Figs 48, 49).

Case (Fig. 119). 'Purse-type', laterally compressed, constructed of silk and covered in fine sand-grains and other inorganic particles and occasionally with diatoms and algal filaments.

Pupa (Fig. 52). Typically hydroptilid, mandibles long, without teeth; pupal case simply a sealed larval case, attached to substrate by anterior and posterior adhesive discs on ventral edge, held vertically.

BIOLOGY. The larvae prefer running water in lakes, streams and rivers, usually on the bottom substrate in association with the green filamentous algae on which they feed. According to Nielsen (1948) the typical habitat of *tineoides* is that of 'stony brooks in shallow water of lakes' while others tend to prefer swifter flowing water and I agree with his observation that this is probably due to true species preferences, as distinct differences have been observed in the habitats of the British species.

Life-cycles are very variable according to species and locality; both univoltine and bivoltine species have been observed. The larvae feed on filamentous green algae by grasping the filament with the modified chelate forelegs, biting into each cell and sucking out the fluid contents.

SPECIES-GROUPS (for species see checklist). The *sparsa*-group: a very large Palaearctic group recognized by the form of the male genitalia (Fig. 115).

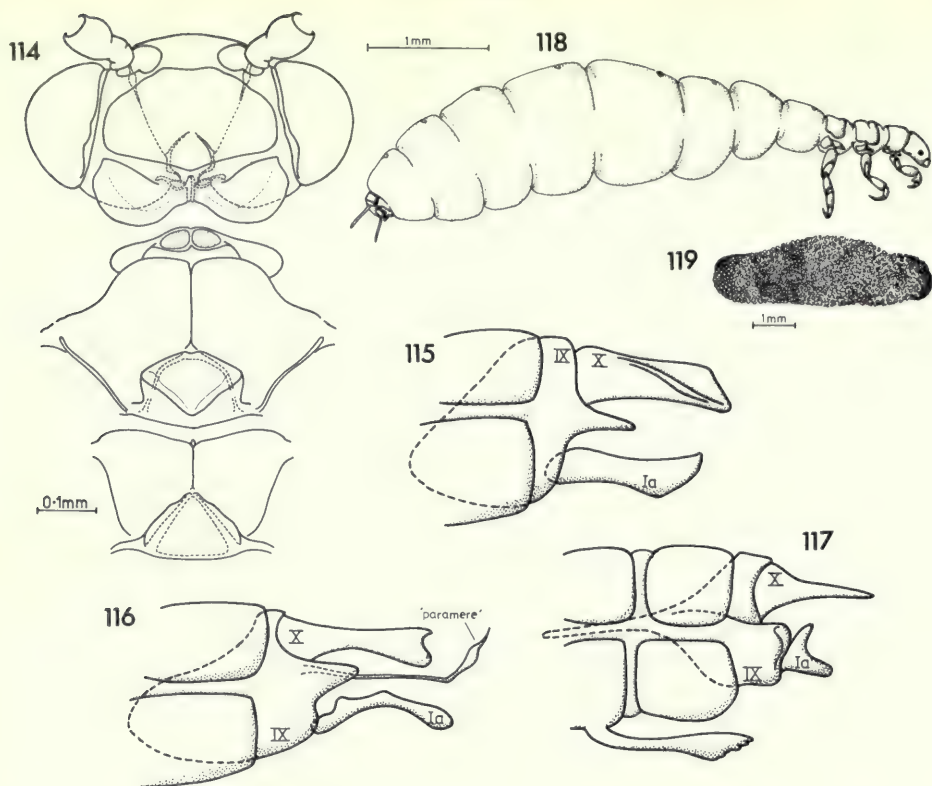
The *uncinata*-group: a small Palaearctic group with characteristic male genitalia which have an affinity with those of the *sparsa*-group.

The *capensis*-group: a small African group possibly derived from the *sparsa*-group.

The *consimilis*-group: a large Nearctic group with a distinctive basic male genitalia form which is close to that of the Palaearctic *sparsa*-group.

The *occulta*-group: a distinct group of approximately 25 species with a distribution extending throughout Europe into Asia Minor, Africa and SE. Asia and with at least 4 Nearctic representatives; male genitalia (Fig. 116).

The *tineoides*-group: *tineoides* is the only Palaearctic member of this predominantly Nearctic group (*moselyi* Ulmer from Peking may also belong here); male genitalia (Fig. 117).



Figs 114–119 *Hydroptila*. 114, adult head and thorax, dorsal view (♂). 115–117, generalized ♂ genitalia; (115) *sparsa*-group; (116) *occulta*-group; (117) *tineoides*-group (vide Figs 15, 16). 118, larva, lateral view; 119, case, lateral view.

The *dikirilagoda*-group: a distinct group of three species from Sri Lanka; possibly related to the *tineoides*-group.

The *losida*-group: a small group of Australasian species (Australia, Tasmania, Solomon Islands (Guadalcanal), New Guinea) which may have some affinity with the SE. Asian members of the *occulta*-group such as *panchaoi*.

The *pulchricornis*-group: a small group of Palaearctic species with possibly one N. African representative.

The *forcipata*-group: of three Palaearctic species; Schmid (1959b) considers that *armathai* belongs here but this is dubious.

The *vectis*-group: two Palaearctic species.

The *tigurina*-group: three distinctive European species with very characteristic sidepieces to segment IX of the male genitalia.

The *waubesiana*-group: a very distinct Nearctic group of seven species.

Incertae sedis: a number of species have not been assigned to any group owing to the unavailability of material for study and the inadequacy of descriptions in the literature.

GENERIC SYNONYMS. *Oxydroptila* is a small genus of only two species, *furcata* Martynov from India and *kirilawela* Schmid from Sri Lanka, which is distinguished from *Hydroptila* on minor venational differences and the form of the male genitalia which is said to resemble that of *Oxyethira*, especially with respect to segment VIII. As in *Hydroptila*, ocelli are absent and the spur formula is 0.2.4; examination of a male paratype of *kirilawela* (BMNH) has revealed the presence of postoccipital scent organs and a thoracic structure identical to that of *Hydroptila*. Contrary to Martynov (1935) and Schmid (1958a), the male genitalia do not resemble those of *Oxyethira* and

the female genitalia of *kirilawela*, as figured by Schmid (1958a), form a simple oviscapt and not the modified, specialized condition characteristic of *Oxyethira* (q.v.). The larvae are unknown. It is therefore proposed to sink *Oxydroptila* as a junior synonym of *Hydroptila* and, although both *furcata* and *kirilawela* are included in the incertae sedis group, they probably form a distinct species unit.

Oeceotrichia, *Pasiotrichia* and *Sumatranotrichia* are three monotypic genera described by Ulmer (1951) from Indonesia (the Sunda Islands) and distinguished from *Hydroptila* solely on minor venational differences. Each has a spur formula of 0.2.4, ocelli absent, male genitalia of the *Hydroptila* pattern and, from examination of type-material (UHZIM loan), postoccipital scent-organs (males) and a thorax identical with those of *Hydroptila*. According to the descriptions and figures of the larvae and cases given by Ulmer (1957), these are also almost identical with those of *Hydroptila* (notably with respect to the fore-tibial process and the three caudal filaments). It would thus appear that *Oeceotrichia*, *Pasiotrichia* and *Sumatranotrichia* are all junior synonyms of *Hydroptila*, the constituent species showing certain affinities, according to the forms of the male genitalia, to the SE. Asian members of the *occulta*-group (e.g. *panchaoi* Schmid) and the Australasian *losida*-group.

As an additional point it was noted, during the examination of Ulmer's Sunda Island material that two females in spirit labelled *Pasiotrichia* bore no resemblance to *Hydroptila*: sp. A had no ocelli but had a thorax resembling that of *Orthotrichia*, and sp. B had 3 ocelli and a thorax similar to that of *Oxyethira* or *Tricholeiochiton*. However, I was not able to identify the specimens positively owing to their fragile conditions.

The following records of material found in the BMNH collections may also be of interest (all det. J. E. Marshall): *palestinae* Botosaneanu & Gasith (1 ♀, Southern Yemen 'W. Aden Protectorate', 1937, Scott & Britton); *triloba* Kimmins (1 ♂, Solomon Islands, Guadalcanal, J. D. Bradley); *vectis* Curtis (1 ♂, Spain, Prov. Granada, Valley of Guadelfeo, 3.vii.1969, Sattler & Carter).

Genus *OXYETHIRA* Eaton

Oxyethira Eaton, 1873 : 143. Type-species: *Hydroptila costalis* Curtis sensu Eaton, by original designation. *Lagenopsyche* Müller, 1879a : 39. Type-species: *Lagenopsyche spirogyrae* Müller, by subsequent designation by Fischer, 1961. [Synonymized by Fischer, 1961.]

Argyrobothrus Barnard, 1934 : 392. Type-species: *Argyrobothrus velocipes* Barnard, by monotypy. [Synonymized by Ross, 1948.]

Loxotrichia Mosely, 1937 : 165. Type-species: *Loxotrichia azteca* Mosely, by original designation. [Synonymized by Ross, 1944.]

Dampftrichia Mosely, 1937 : 169. Type-species: *Dampftrichia ulmeri* Mosely, by original designation and monotypy. [Synonymized by Ross, 1944.]

Oxytrichia Mosely, 1939a : 289. Type-species: *Oxytrichia mirabilis* Mosely, by original designation and monotypy. [Synonymized by Kimmins, 1966.]

DISTRIBUTION. Cosmopolitan (excluding polar regions).

Oxyethira is a very successful genus of approximately 75 species with a world-wide distribution and with very distinctive larvae which feed on green filamentous algae. The true identity of the type-species is still in dispute. Eaton originally proposed the genus for two species, *Hydroptila costalis* Curtis and *H. albiceps* McLachlan, the latter being an endemic New Zealand species. Eaton (1873) considered *costalis* (Curtis) to be a senior synonym of *H. tineoides* Dalman sensu Stephens and, doubtfully, of *H. flavicornis* Pictet. However, subsequent dissection of Curtis's male type of *costalis* by Neboiss (1963) showed this to be conspecific with *Orthotrichia tetensis* Kolbe, the latter being placed as a junior synonym of *costalis* (Curtis) and congeneric with *angustella* (McLachlan), the type-species of *Orthotrichia*. The next available name for *costalis* (Curtis) sensu Eaton is *Oxyethira flavicornis* (Pictet).

This is still not an unequivocal solution to the problem, however, since Pictet's type-specimen of *flavicornis* has not yet been located (one female specimen in Geneva is labelled 'Zurich 9/81' and a second specimen has no abdomen according to Neboiss, 1963). Neboiss therefore merely proposes the synonymy as 'one of the possible answers' but does not ignore the fact that *flavicornis*

Pictet could be a synonym of *H. tineoides* Dalman sensu Stephens, thus leaving *costalis* (Curtis) sensu Eaton without a name. However, until the problem can be resolved (and this is unlikely since Pictet's type appears to be missing), the proposal of Neboiss (1963) must be accepted. Nevertheless, there is no doubt as to the actual species referred to by Eaton since his figures of the distinctive male genitalia are clearly recognizable (he merely considered that *costalis* Curtis was the same species).

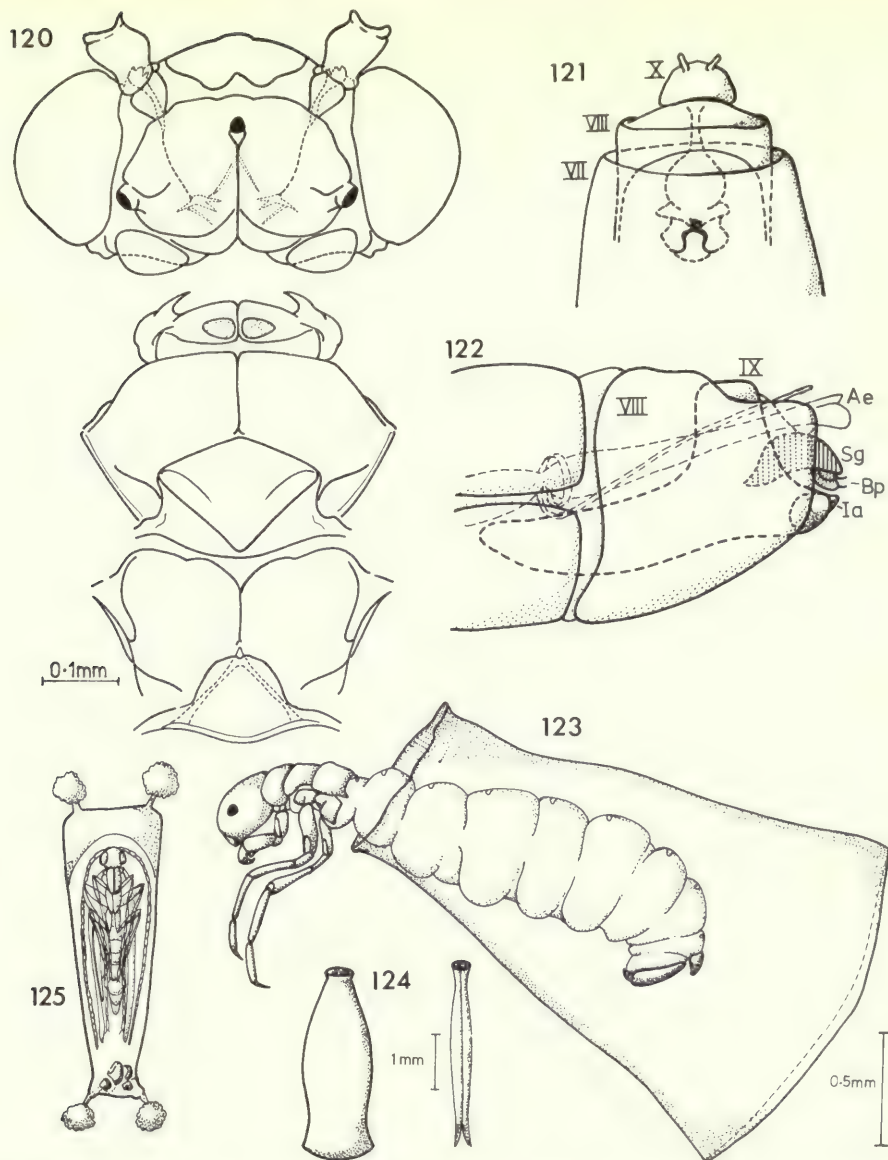
The larval stages of *Oxyethira* (discounting Pictet's (1834) figures of *H. flavicornis*) were first described by Müller (1879a) as *Lagenopsyche spirogyrae* Müller from Brazilian material. The first description of British material was by Morton (1887) from specimens of *O. costalis* (Curtis) sensu Eaton sent to him by McLachlan and Hudson (1886) described larvae of an unidentified New Zealand hydroptilid which subsequently proved to be *O. albiceps* McLachlan. The most detailed larval description is that of *O. costalis* (Curtis) sensu Eaton as given by Nielsen (1948) upon which the generic diagnosis given below is partly based. The following list summarizes the published descriptions of species of *Oxyethira* larvae to date (the type-species will now be called *flavicornis*).

O. albiceps (Mosely & Kimmins, 1953); *delcourtii* (Jacquemart, 1973); *distinctella* (Lepneva, 1964); *dualis* (Sibley, 1926); *ecornuta* (Lepneva, 1964); *flavicornis* (Nielsen, 1948; Lepneva, 1964; Hickin, 1967); *frici* (Lepneva, 1964); *hyalina* (Müller, 1879a); *incana* (Ulmer, 1957); *meridionalis* (= *unidentata*) (Jacquemart & Coineau, 1962); *puertoricensis* (Flint, 1964); *sagittifera* (Lepneva, 1964); *serrata* (Ross, 1944); *simplex* (Macdonald, 1950; Hickin, 1967); *tristella* (Lepneva, 1964); *velocipes* (Barnard, 1934).

Apart from Kimmins's (1958) paper on the British species of *Oxyethira* there has been no previous review of the genus as a whole. The following diagnosis and species-groupings have been based on published species descriptions and examination of adult and larval material in the BMNH collections. To date there are approximately 75 species which fall into more or less distinct species-groups each distinguished by the form of the male genitalia. The status of *Stenoxyethira* Kimmins will be discussed later but, according to Schmid (1958a), it should be considered a synonym of *Oxyethira*.

DIAGNOSIS. *Adult.* Forewing length 2.5–3.5 mm: head and antennae unmodified (Fig. 120); anterior tentorial arms reduced medially; ocelli 3; thorax (Fig. 120) – mesoscutellum with anterior margin convex and posterior margins slightly concave, metascutellum convexly subtriangular: spur formula 0.3.4: ♀ genitalia a modified oviscap (Fig. 121) (after Kimmins, 1958) with sternite VI with a short, acute ventral process; segment VII with tergite and sternite more or less fused, ventral apical margin sometimes excised; tergite VIII reduced to a narrow arched band, the centre of its apical margin produced as a spatulate lobe; sternite VIII forming a short 'subgenital plate'; tergite IX either free or fused to VIII, short and hood-like; tergite X forming a short, broad plate carrying two short slender cerci; details of internal vaginal structures obscure but apparently with an upper and lower lobe, the latter with a conspicuous baso-ventral process directed caudad: ♂ genitalia (Fig. 122) (after Kimmins, 1958) with sternite VII with short, acute ventral process; segment VIII with tergite and sternite more or less fused, apical margins dorsally and ventrally excised, that of tergite with dorsal or lateral processes, the latter sometimes armed with stout spines; segment IX mostly withdrawn into VIII, its upper half generally much shorter than lower, often reduced to a short transverse band, lateral apical margins of IX sometimes produced or with variously formed spiniform processes, ventral margin generally excised and from which arises a lobe; tergite X obscure, membranous; subgenital appendages represented by two sclerotized plates attached to segment IX, fused basally with their apices variously hooked downwards ('fused claspers' (Kimmins, 1958); 'lower penis cover' (Mosely, 1939a); 'subgenital plate' (Ross, 1948)); above and arising from them are two pairs of short, membranous 'bilobed' processes each terminating in a short apical seta; aedeagus long and slender with a spiniform 'titillator' arising at midlength.

Larva (Fig. 123). Head elongate, of uniform diameter, slightly laterally compressed; dorsal and ventral ecdysial lines distinct; postmental sclerites paired, anterior ventral apotome well developed, U-shaped with a distinct transverse ridge, posterior ventral apotome present (Fig. 27); labrum with strongly convex lateral margins and deep median anterior indentation; mandibles asymmetrical – left with projecting blades bearing small teeth and with a median brush, right with blades poorly defined and distal only, teeth only near apices: thoracic pleurites of each segment fused except for the free anal epimeron of the prothorax; three sternites present on each thoracic segment (Fig. 41); forelegs short with small baso-ventral setate lobe on femur and long distal process bearing a ventral row of short, spine-like setae on tibia



Figs 120–125 *Oxyethira*. 120, adult head and thorax, dorsal view; 121, generalized ♀ genitalia, ventral view; 122, generalized ♂ genitalia, lateral view (*vide* Figs 15, 16); 123, early fifth instar larva in case, lateral view; 124, late fifth instar larval case, lateral views; 125, pupa in case, ventral view.

(chelate); mid- and hindlegs twice as long as forelegs, tarsal claws long and slender: abdomen typically distended, intersegmental constrictions distinct; laterally compressed and usually held in characteristic comma-shaped attitude; dorsal 'rings' present on segments II–VII; tergites absent except on segment IX; anal prolegs fused to side of segment X; caudal gills absent.

The early instars of *flavicornis* (Pictet), as *costalis* (Curtis), are described and figured in Nielsen (1948).

Case (Figs 123, 124). Laterally compressed, semi-transparent, constructed of secretion only; 'jug-' or 'bottle'-shaped; posterior end broad with slit-like opening, anterior end narrow, constricted to form a neck with a well-defined rim around the opening. The pupal case (Fig. 125) is basically a sealed larval case attached horizontally to the substrate by four short ligaments, each with an adhesive disc and arising from each corner (in some species there are two ligaments from each of the anterior corners); the pupa

lies with its head towards the broad (hence anterior) end (cf. larva), with its dorsum towards the substrate; the case is closed anteriorly by a narrow curved membrane, the posterior neck being filled with a plug of silk; the pupal cases usually occur on aquatic plants, rarely on submerged rocks or wood.

Pupa. Typically hydroptilid; mandibles long with serrate inner blades.

BIOLOGY. The larvae are generally considered to occur in plant thickets in slow-moving and static bodies of water in association with the green filamentous algae upon which they feed. This is true for *distinctella*, *ecornuta* and *sagittifera*, for example (Lepneva, 1964), and also *velocipes* (Barnard, 1934) and *spirogyrae* (Müller, 1879c) but a number of species are reputed to frequent faster-flowing streams where the larvae are found on the rocky substrate in areas covered with algae; these are *frici* and *tristella* (Lepneva, 1964), *azteca* (or *janella*) (Flint, 1968a) and *hyalina* (Müller, 1879c). *O. flavicornis* (Pictet) (*costalis* Curtis sensu Eaton) is a pond dweller although, in Pictet's (1834) original description, the larva of *flavicornis* is reputed to occur in fast-flowing streams with *Hydroptila pulchricornis* Pictet, thus casting further doubts on the identity of *flavicornis* (see above). In Illinois, Ross (1944) records pupae of *serrata* from the underside of rocks in about 1 m of water along the open beaches of glacial lakes. Pupal cases of *albiceps* in New Zealand, according to Hudson (1886), were found attached to stones in streams, especially in the late summer when 'the rivers are generally very low . . . and a luxurious growth of green slime weed is present'. Finally, *puertoricensis* is found in all types of streams and at all elevations in Jamaica (Flint, 1968b) and, on Puerto Rico (Flint, 1964), the cases are found 'in tangles of filamentous green algae' and are fixed to irregularities in the rocks at pupation.

The larvae are highly specialized for feeding on filamentous algae and for living in masses of vegetation as indicated by their chelate forelegs, laterally compressed bodies and very long, slender mid- and hindlegs. According to Siltala (1907) gut contents of an *Oxyethira* species included diatoms and entire algal filaments and Jacquemart & Coineau (1962) similarly record diatoms and desmids (the normal food source is reputed to be simply the fluid contents of algal cells). Nielsen (1948) describes the case building behaviour of *flavicornis* while Jacquemart & Coineau (1962) describe the similar habits of an unidentified *Oxyethira* species.

SPECIES-GROUPS. At least 10 species-groups may be recognized by the form of the male genitalia. The following groupings have been based on relationships suggested in original species descriptions and have been verified by me as far as the literature and available material would allow. The lists of species are given in the checklist.

The *falcata*-group: essentially a western Palaearctic group of seven species, three occurring only in the Atlantic Islands, and with possibly one Nearctic representative. Two species (*falcata* and *frici*) are British. The group is distinguished by the spinose postero-lateral processes of the male segment VIII. There is still some doubt as to the status of *fischeri* and *dentata* which both have very similar genitalia to those of *falcata*; as Higler (1974) points out in his paper on *fischeri*, *falcata* may exhibit 'eco-geographic' forms (after Jacquemart & Coineau, 1962) and he considers that *dentata* may belong to one of these forms. However, Higler believes that *fischeri* is distinct from *falcata*, mainly on account of features of the male aedeagus (based on the figures of *falcata* in Jacquemart & Coineau, 1962) although Mosely's (1939a) figures of the aedeagus of *falcata* are very similar to Higler's figures of *fischeri*! A thorough study of *falcata* and its reputed close relatives is obviously required in order to sort out this species-complex. *O. borella* also is close to *falcata* but would seem to be distinct according to both male and female genitalic characters (Svensson & Tjeder, 1975).

The *flavicornis*-group: a Palaearctic group extending from Europe (and Egypt) to Korea with perhaps one species from Sri Lanka. It may be related to the Nearctic *rivicola*-group and is distinguished by the absence of a median ventral lobe on the fused claspers and the broad, widely separated subgenital plates (in ventral view).

The *rivicola*-group: possibly related to the *flavicornis*-group and, although essentially Nearctic, may contain a number of Neotropical members (from Surinam, described by Flint, 1974).

The *simplex*-group: again possibly related to the *flavicornis*-group; this group may require further investigation as, at present, it contains two geographically distinct elements: *simplex* and

tristella from northern Europe and NW. U.S.S.R., and *paramartha*, *ramosa*, *harpagella* and *galekoluma* (and, possibly, *Stenoxyethira excisa*) from SE. Asia.

The *distinctella*-group: a small Holarctic group distinguished by the prominent dorso-lateral posterior serrate processes of the male segment VIII.

The *azteca*-group (= *Loxotrichia* Mosely): a small group from Central America and the Antilles, characterized by the form of the male segment IX. *O. archaica* Malicky from Portugal would also appear to belong here, its occurrence in this region possibly being a result of a chance introduction from S. America (the group occurs, for example in Brazil); it is unlikely that it is an early Tertiary relict as stated by Malicky (1975).

The *ulmeri*-group (= *Dampftrichia* Mosely): another small Nearctic group distinguished by the dorso-lateral tapering processes of segment IX.

The *zeronia*-group: essentially Central American and characterized by the anterior prolongation of the ventral margin of segment IX.

The *pallida*-group: a small but distinct Nearctic group of uncertain affinities.

The *bidentata*-group: a Nearctic–Neotropical group of three species.

The *mirabilis*-group: containing *mirabilis* (Palearctic) and *flagellata* (Reunion Island); the latter has some affinity with *bidentata* which itself was once included with *mirabilis* in the genus *Oxytrichia*.

Incertae sedis: of these, *albiceps* is endemic to New Zealand and *velocipes* to South Africa; *spirogyrae* and *hyalina* (*Lagenopsyche*) from Brazil are known only in their larval stages; *incana* (Indonesia) was described from the female and larva only (Ulmer, 1951; 1957), while *angustella* is known from the wings alone. *O. anabola* and *berneri* are distinct Nearctic species while *mithi*, from Greece, has not yet been placed.

Genus *STENOXYETHIRA* Kimmins

Stenoxyethira Kimmins, 1951 : 207. Type-species: *Stenoxyethira minima* Kimmins, by original designation.

Gnathotrichia Ulmer, 1951 : 59. Type-species: *Gnathotrichia isabellina* Ulmer, by original designation and monotypy. **Syn. n.**

DISTRIBUTION. SE. Asia (Burma, Indonesia).

Kimmins (1951) erected *Stenoxyethira* principally for the type-species, *minima*, but included, somewhat doubtfully, *excisa* Kimmins on the basis of the general similarity of the wing venation. The genus is here considered to contain just these two species with *Gnathotrichia isabellina* treated as a synonym of *Stenoxyethira excisa*. The following generic diagnosis is based on Kimmins (1951). The immature stages are unknown.

DIAGNOSIS. *Adult.* Forewing length 1.6 mm: head and antennae unmodified; ocelli 3; spur formula 0.2.4 (0.3.4 in *excisa* and *isabellina*): ♂ genitalia (cf. Fig. 122) with segment VIII forming a ring concealing segment IX, latter narrow and lightly sclerotized dorsally, ventral margin produced as a rounded, bilobed plate (fused inferior appendages ?) above which is a triangular, trough-shaped subgenital plate; tergite X difficult to interpret; aedeagus rod-like, with a single spine or sheath.

S. excisa was included in this genus on the basis of venational features, being distinguished from *minima* by the presence of a small spine or microscopic spur on the mid-tibia, the form of the aedeagus and the produced spines of segment VIII of the male genitalia. Kimmins (1951) was in no way satisfied with this arrangement and noted on the card for *Stenoxyethira* in the BMNH index (Hydroptilidae) ‘?= *Gnathotrichia* Ulmer, 1951’. I noted independently of Kimmins the similarity between these two genera when examining type-material of *G. isabellina* Ulmer (UHZIM loan) and concluded that this species, from Java and Sumatra, was probably synonymous with *S. excisa* Kimmins. According to the dates of publication (Kimmins, March, 1951; Ulmer, April, 1951) *S. excisa* takes priority. However, as Schmid (1958a) points out, *S. excisa* may truly belong in *Oxyethira*, being closely related by the form of the male genitalia and wing venation to *O. galekoluma* Schmid from Sri Lanka (the venation of the latter approaching that of *G. isabellina* and *O. angustella* Martynov). I agree that there is a similarity in form which is also supported by the spur formula (0.3.4) and the structure of the thoracic nota, but I do not agree with Schmid

that Kimmins's figures of the male genitalia of *S. excisa* are inverted in comparison with those of *O. galekoloma* (Schmid, 1958); on the contrary, it is Schmid who has misinterpreted their orientation.

It would thus seem that *Stenoxyethira* and *Gnathotrichia* should be regarded as synonyms of *Oxyethira*, at least with regard to *S. excisa*. The status of *S. minima* is not so easily resolved – as regards venational and male genitalic characters it could well be a specialized member of *Oxyethira*, although it is the only species so far recorded without a preapical spur on the mid-tibia. This may simply prove to be a specific or even individual variation; as in most of these problems the solution must await the collection and examination of further material. In conclusion, therefore, it is proposed to retain the genus *Stenoxyethira* for the time being with *Gnathotrichia* as a junior synonym although the latter should probably more correctly be placed as a synonym of *Oxyethira* along with *Stenoxyethira excisa*. In this case the genus *Stenoxyethira* may need to be retained solely for the type-species, *minima*, although this may also prove to belong in *Oxyethira*.

Genus *PAROXYETHIRA* Mosely

Paroxyethira Mosely, 1924 : 670. Type-species: *Paroxyethira hendersoni* Mosely, by subsequent designation by Mosely & Kimmins, 1953.

DISTRIBUTION. New Zealand.

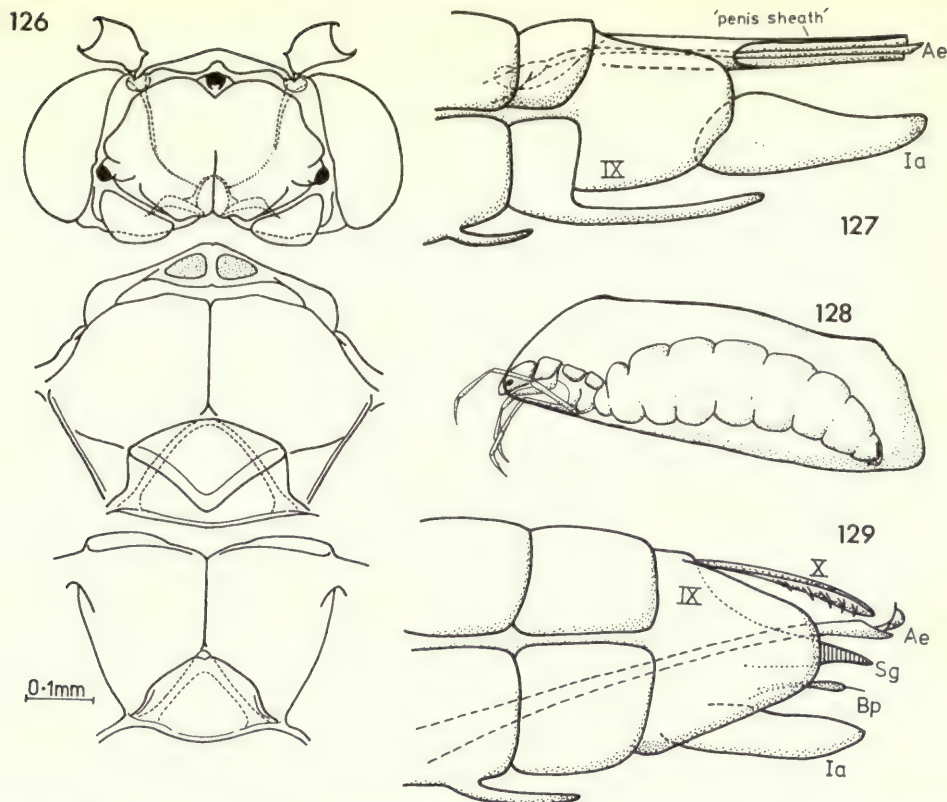
This endemic New Zealand genus contains five species although I believe that further species are at present being described (F. B. Michaelis, pers. comm.). Mosely (1924) originally described *eatoni*, *tillyardi* and *hendersoni*; *hintoni* and *kimminsi* being subsequently described by Leader (1972) in which paper a key to all males and females was provided. Leader (1970) also discussed the function of the setal equipment of the early and fifth instar larvae of *Paroxyethira*, giving very generalized figures of each but no detailed morphological descriptions. *Paroxyethira* is characterized by the unique forms of both the male and female genitalia, especially the elongate inferior appendages and ventral processes of the former, and the general appearance of the larva and its case. The following diagnosis is based on Leader (1972) and Mosely's original material (BMNH collection).

DIAGNOSIS. *Adult*. Forewing length 2.5–3.5 mm: anterior tentorial arms reduced to fine strands medially (Fig. 126); antennae of approximately 25–40 segments; ocelli 3: thorax (Fig. 126) as in *Xuthotrichia*: spur formula 0.3.4: ♀ genitalia a modified oviscapt with sternite VI with a small ventral 'tooth'; posterior margin of sternite VII with a triangular ventral process; tergite VIII deeply excised dorsally and elongate postero-ventrally, almost meeting mid-ventrally; sternite VIII small, appearing as a small lobe just above the projection from VII; segment IX small, mostly concealed by VIII; segment X small, bilobed, each lobe with a short apical cercus: ♂ genitalia (Fig. 127) with sternite VII with an elongate flattened ventral process extending beyond the posterior margin of segment IX; segment IX fused, with a deep postero-dorsal excision such that the segment is incomplete dorsally; tergite X absent; inferior appendages basically elongate, concave with apices directed inwards; aedeagus with a very characteristic basal, sleeve-like sheath with the posterior margin produced as a long spine extending almost to the apex of the aedeagus, latter long and slender with a short, broad proximal region which tapers anteriorly to a distinct constriction just before which arises a spiral process or 'titillator'.

Larva (Fig. 128). According to Leader (1972) the larva of *Paroxyethira* differs from that of *Oxyethira* only in the possession of a complex spine on the ventral process of the fore-tarsus which resembles the fan-like seta present on the fore-tarsus of *Hydroptila* (cf. Fig. 47). As in *Oxyethira*, the legs of *Paroxyethira* are longer and more slender than those of *Hydroptila* but apart from these general points no further comparisons can be drawn. Leader (1972) states that the five species of *Paroxyethira* can only be distinguished by the fine sculpturing of the thoracic sternites which, however, tends to be rather an inconsistent feature and thus not a reliable taxonomic character.

Case (Fig. 128). 'Purse-type', constructed of secretion only, oblong and sometimes with outward pointing anterior and posterior ventral spines as extensions of the ventral seam by which the case is attached to the substrate (pupal).

BIOLOGY. According to Pendergrast & Cowley (1966), the larvae of *hendersoni* are abundant in vegetation in lakes, ponds and streams where filamentous green algae occur. Leader (1972) briefly gives collecting data for each species.



Figs 126–129 Hydroptilini, *Oxyethira*-group. 126–128, *Paroxyethira*; (126) adult head and thorax, dorsal view; (127) generalized ♂ genitalia, lateral view; (128) larva in case, lateral view. 129, *Xuthotrichia*, generalized ♂ genitalia, lateral view (vide Figs 15, 16).

DISCUSSION. From features of the adult head and thorax and the basic form of the female genitalia, I consider *Paroxyethira* to be closely allied to the endemic Australian genus *Xuthotrichia* Mosely. The general morphology and habits of the larvae suggest that it may, along with *Xuthotrichia*, be an offshoot of the *Oxyethira* branch of the Hydroptilini.

Genus *XUTHOTRICHIA* Mosely

Xuthotrichia Mosely, 1934 : 139. Type-species: *Xuthotrichia ochracea* Mosely, by original designation.

DISTRIBUTION. Australia.

This endemic Australian genus is known from the four original species described by Mosely (1934) (*ochracea*, *simplex*, *fimbriata* and *eskensis*), and I believe that more species are being described (A. Wells, *in litt.*) and there are specimens of an unidentified (and possibly new) species from Western Australia in the BMNH collections.

The genus is characterized by the unique form of the male genitalia which show considerable specific variation; they are asymmetrical and often very complex, and identification of species is very difficult from Mosely's original descriptions. The females have not been described but from examples in the unidentified material in the BMNH collections mentioned above the genitalia appear to bear some resemblance to those of *Paroxyethira*. The immature stages are unknown although a figure of an unidentified Australian hydroptilid larva in Riek (1970) greatly resembles that of *Paroxyethira* in general appearance (cf. Fig. 128) and, if so, may be the larva of *Xuthotrichia* (see *Paroxyethira* account). The case of the larva figured in Riek (1970) is constructed of silk and sand-grains although, according to A. Wells (*in litt.*), the cases of larvae which she believes

to be of *Xuthotrichia* (larvae not described, however) are of secretion only but of a slightly different shape to those of *Paroxyethira* (also of secretion only). It would be necessary to compare specimens of the two genera, however, before any conclusions regarding affinities could be drawn.

The following diagnosis is based on a study of material in the BMNH collections (Mosely's types) and the original descriptions.

DIAGNOSIS. *Adult.* Forewing length 2.5–3.0 mm: anterior tentorial arms reduced to fine strands medially; antennae c. 40-segmented; ocelli 3: mesoscutellum similar to that of *Hydroptila* and *Oxyethira* (cf. Figs 114, 120); metascutellum pentagonal with slightly anteriorly convergent lateral sides: spur formula 0.3.4: ♂ genitalia (Fig. 129) – sternite VII with a moderately long, slender ventral process; segment VIII unmodified; segment IX fused, usually obliquely truncate in lateral view, dorsal and ventral margins more or less excised; tergite X, inferior appendages, subgenital appendages, subgenital plate and bilobed process very variable; aedeagus long and slender, without a median constriction or spiral process but sometimes with additional short lateral processes arising just before apex.

BIOLOGY. According to A. Wells (*in litt.*), the larvae of *Xuthotrichia* occur in all types of still water in Australia such as lakes, billabongs, etc.

DISCUSSION. *Xuthotrichia* may be closely related to *Paroxyethira* as indicated by adult head and thoracic features (and also, possibly, by the general form of the larva); these genera may in turn be allied to the cosmopolitan genus *Oxyethira*.

Genus *TRICHOLEIOCHITON* Kloet & Hincks

Leiochiton Guinard, 1879 : 139. Type-species: *Leiochiton fagesii* Guinard, by monotypy. [Preoccupied by *Leiochiton* Curtis, 1831 in Coleoptera.]

Tricholeiochiton Kloet & Hincks, 1944 : 97. [Replacement name for *Leiochiton* Guinard.]

Synagotrichia Ulmer, 1951 : 81. Type-species: *Synagotrichia fortensis* Ulmer, by original designation and monotypy. **Syn. n.**

DISTRIBUTION. W. Palaearctic; SE. Asia (Burma, Indonesia).

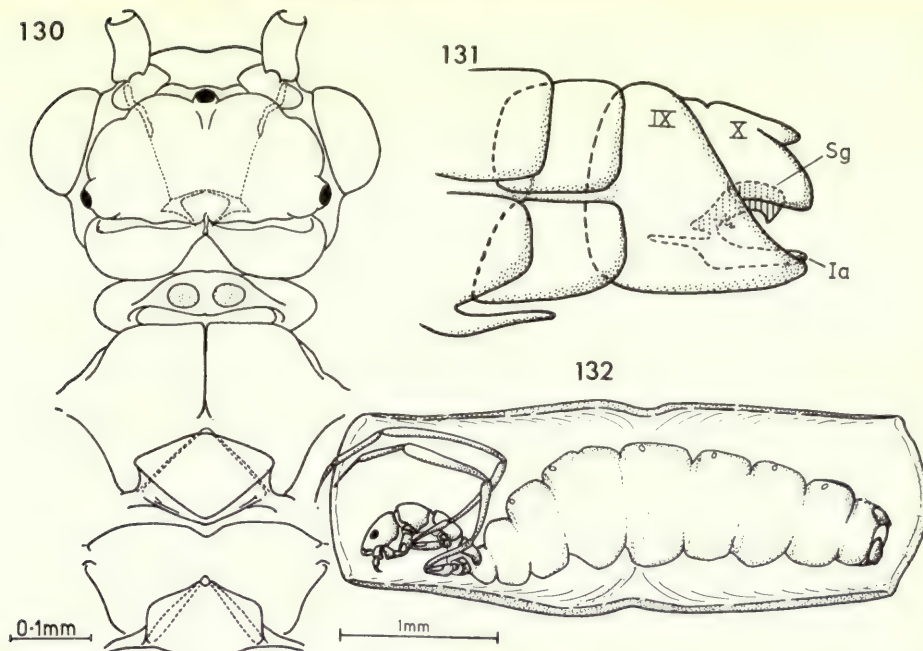
The genus *Tricholeiochiton* contained originally only two species, *fagesii* (Guinard), which is known locally from Europe and the U.S.S.R., and *lacustris* Kimmins from Burma (S. Shan States). Examination of type-material of *Synagotrichia fortensis* Ulmer (UHZIM loan) reveals that this genus should be regarded as a junior synonym of *Tricholeiochiton*.

The unique larva of *fagesii* was first noticed by Bremi who gave an extended description of it under the name of *Hydroptila flabellifera* in a letter to Hagen which was published by the latter in 1864. Hagen considered the species to belong to the genus *Agraylea* due, possibly, to the shape of the case which was covered with filaments of 'Confervae' (?). However, it is now known that the cases of *Tricholeiochiton* are constructed of secretion only and that Bremi's *H. flabellifera* consisted of a mixed series of *T. fagesii* and *Agraylea sexmaculata* Curtis.

The next reference to the larva was in 1867 when Dr Barker presented a series to the Dublin Microscopical Society as specimens of Diptera. Then, in 1878, Guinard published figures of the larva and, albeit rather crudely, the male genitalia, and named the species *Leiochiton fagesii*. The species has since been variously referred to as *Oxyethira fagesii* and *O. felina* Ris, and was first recorded on the British list by Mosely (1932) who subsequently recognized the synonymy with *L. fagesii* (Mosely, 1939a). The generic name was changed to *Tricholeiochiton* by Kloet & Hincks (1944) when it was discovered that *Leiochiton* was preoccupied in Coleoptera.

The larva of *fagesii* has been described a number of times but not in any great detail. The account given below is based on Lepneva (1964) and a study of material donated to the BMNH by Dr B. Higler (Netherlands) and Dr I. D. Wallace (MCM). A formal description has not been given since it is understood that Wallace (pers. comm.) proposes to publish a full account based on recently discovered British material.

Kimmins (1951) described a second species, *lacustris*, from Burma in which the male genitalia are almost identical with those of *fagesii* except for the presence of a long ventral process on the seventh abdominal sternite. The immature stages of *lacustris* are unknown.



Figs 130–132 *Tricholeiochiton*. 130, adult head and thorax, dorsal view; 131, generalized ♂ genitalia, lateral view; 132, larva in case, lateral view.

From the form of the male genitalia, wing venation and shape of the metascutellum, *Synagotrichia fortensis* Ulmer, from Indonesia (Sumatra), probably represents a third species of *Tricholeiochiton*. Discovery of the larval stages, however, would confirm this view.

DIAGNOSIS. Adult. Forewing length 2.25–3.00 mm: anterior tentorial arms reduced to fine strands medially (Fig. 130); antennae of *c.* 37 segments in *lacustris*; ocelli 3: metascutellum pentagonal, lateral sides slightly divergent anteriorly: spur formula 0.3.4: lateral processes of abdominal sternite V absent, basal pit with characteristic sculpturing in *fagesii* (Fig. 13): ♀ genitalia an oviscapt: ♂ genitalia very distinct, but very similar in the three known species (Fig. 131) – sternite VII sometimes with a long, slender ventral process; segment VIII unmodified; segment IX fused, produced ventro-posteriorly (obliquely truncate in lateral view), dorsal and ventral posterior margins deeply incised; segment X forming a dorsal membranous lobe with a pair of postero-ventrally produced lateral processes which partly enclose the aedeagus; inferior appendages small, fused baso-medially, contained within ventral incision of IX and concealed by latero-ventral processes of IX; subgenital plate transverse with down-curved posterior ‘lip’ and produced antero-ventrally to join the inferior appendages, base of plate with a pair of small seta-bearing processes, junction of plate and inferior appendage produced anteriorly as a slender truncate process; aedeagus short and robust with a distinct median constriction, just before which arises a slender spiral ‘titillator’ which has a slightly dilated apex (homologies of genitalia uncertain).

Larva (Fig. 132). Head long and slender with parallel sides; dorsal ecdysial lines indistinct anteriorly; tentorial pits distinct; ‘postmental sclerites’ crescent-shaped, undivided, with short blunt postero-median process (Fig. 23); mandibles typically subtriangular with slender pointed apices, left with bluntly toothed dorsal blade: thoracic nota paired; three well-developed sternites on prothorax only (Fig. 46); pleurites with preepisternite fused in all three segments (according to Lepneva, 1964); forelegs short, tibiae with distinct disto-ventral processes bearing apical spines and a row of short ventral setae; mid- and hindlegs characteristically very long and slender, achieved by elongation of trochanter, femur, tibia and tarsal claw: abdomen long, more slender than in other Hydroptilidae, characteristically curved; tergite on segment IX only; anal prolegs fused to X, anal claw short; dorsal ‘rings’ present on segments III–VIII.

Case (Fig. 132). ‘Purse-type’, oblong, ‘sac-shaped’, sides slightly convex, constructed of secretion only.

Pupa. Undescribed but pupal case with two stalked attachment discs at each anterior corner and one at each posterior corner.

BIOLOGY. According to Lepneva (1964) the larvae of *fagesii* inhabit stagnant and slow-moving bodies of water in plant thickets, the pupal cases being attached to the undersides of aquatic plants.

DISCUSSION. The form of the male aedeagus and the algae-associated habits of the larval stages indicate that *Tricholeiochiton* is a member of the Hydroptilini. Although obviously very specialized with respect to both the male genitalia and the morphology and habits of the larvae, the general appearance of the latter and the form of the adult head and thorax are suggestive of the genus *Oxyethira*, of which branch of the Hydroptilini *Tricholeiochiton* may be an early offshoot. The disjunctive distribution of this genus is rather unusual with only two Oriental and one Palaearctic representatives. The latter may have been due to an early introduction of ancestral stock from the Oriental region.

Tribe **ORTHOTRICHINI** Nielsen **stat. n.**

Orthotrichiinae Nielsen, 1948 : 186. Type-genus: *Orthotrichia* Eaton, 1873.

Nielsen erected the subfamily Orthotrichiinae for two genera, *Orthotrichia* and *Ithytrichia*, on the basis of larval morphological and behavioural affinities. Although the adults and larvae are very distinctive for each genus, the larvae exhibit a number of fundamental similarities which distinguish them from other members of the Hydroptilinae. However, according to certain adult features, such as the structure of the head and thorax and the male aedeagus, the Orthotrichiini appears to have arisen from an early Hydroptilini-type ancestor. I therefore propose to accept Nielsen's original grouping but as a tribe of the subfamily Hydroptilinae and with the inclusion of *Ithytrichia* remaining open to further speculation; the latter may later be found to form a distinct unit on its own.

DIAGNOSIS. *Adult.* Forewing length 2–4 mm; tentorium complete (Figs 133, 139); ocelli 3 or 0; post-occipital lobes unmodified; thoracic nota variable (Figs 133, 139); mesonotum without transverse suture; spur formula 0.3.4; abdominal sternite V with typical setate process: ♀ genitalia basically a simple oviscap, modified in *Orthotrichia* (Fig. 134); ♂ genitalia very characteristic for each genus, highly asymmetrical in *Orthotrichia* (Figs 135, 140); aedeagus with spiral 'titillator'.

Larva. Both *Orthotrichia* and *Ithytrichia* have very distinct and specialized larval stages. Their characteristic features, on the basis of which Nielsen (1948) grouped the genera together, are as follows. Labium broad and flat; mandibles flattened, tapering; general form of the ventral apotome and 'postmental sclerites' (Figs 24, 28); the thoracic sternites (Fig. 42); the comb-like setae of the fore-coxae; the circle of 'rings' on abdominal segment I and the single median caudal filament from segment X. The cases of the larvae of each genus are also very characteristic, neither being of the typical 'purse-type'.

Pupa. Typically hydroptilid, mandibles long and untoothed.

DISCUSSION. According to Nielsen (1948) *Ithytrichia* and *Orthotrichia* may be derived from a common ancestor which was probably associated with filamentous green algae; this, in my opinion, probably occurred early in the evolution of the Hydroptilini. *Orthotrichia* became a highly efficient algal feeder living in plant thickets in sluggish to still water while *Ithytrichia*, possibly in association with the colonization of rheophilous and semi-exposed habitats, secondarily adopted the detritus-feeding habit but retained a number of morphological features derivable from algal-feeding ancestors. Such features which are shared by *Ithytrichia* and *Orthotrichia* larvae are the broad, flat labium; the flattened mandibles; the form of the ventral apotomes and postmental sclerites (cf. Figs 24, 28) and the thoracic sternites (Fig. 42); the comb-like setae of the fore-coxae; the complete circle of abdominal 'rings' on segment I and the possession of a single median caudal filament which, according to Nielsen (1948), is present in the early instars of *Orthotrichia*.

On the basis of these larval affinities, Nielsen proposed the subfamily Orthotrichiinae for *Orthotrichia* and *Ithytrichia* and, although the larvae and adults of these two genera have evolved along different lines, I am retaining Nielsen's grouping but as a tribe of the Hydroptilinae. The Orthotrichiini is thus, on the basis of the form of the adult thorax, male aedeagus and fundamental larval associations with filamentous algae, a highly specialized and probably early offshoot of the Hydroptilini line. *Orthotrichia* is a very successful genus which has a wide present-day distribution

although no species have yet been recorded from the Neotropical and Australian regions. *Ithytrichia* is less well represented with only three recognized Holarctic species and possibly one Indonesian. Until the genus is better known, however, its origins and evolutionary history must remain speculative.

Genus *ORTHOTRICHIA* Eaton

Orthotrichia Eaton, 1873 : 141. Type-species: *Hydroptila angustella* McLachlan, by original designation. *Clymene* Chambers, 1873 : 114. Type-species: *Clymene aegerfasciella* Chambers, by monotypy. [Synonymized by Flint, 1966.]

Javanotrichia Ulmer, 1951 : 75. Type-species: *Javanotrichia maeandrica* Ulmer, by original designation. **Syn. n.**

Orthotrichiella Ulmer, 1951 : 79. Type-species: *Orthotrichiella ranauana* Ulmer, by original designation and monotypy. **Syn. n.**

Baliotrichia Ulmer, 1951 : 88. Type-species: *Baliotrichia litoralis* Ulmer, by original designation and monotypy. **Syn. n.**

DISTRIBUTION. Holarctic; Africa; SE. Asia (to New Guinea).

Orthotrichia is a very successful genus with approximately 40 species and with an almost continuous world-wide distribution, although it has not so far been recorded from Central or South America or the Australian region. The genus is well represented in the Palaeotropical regions of Africa and SE. Asia, through Indonesia (Sunda Islands) to New Guinea (Papua) and, possibly, Fiji and Borneo (unidentified species, BMNH collections, det. J. E. Marshall). The adults are characterized by the uniquely developed asymmetrical male genitalia and the absence of ocelli (cf. *Hydroptila* which may be distinguished by the presence of postoccipital scent organs in the males). The larvae are associated with aquatic vegetation in standing waters and are highly specialized for feeding on the cell contents of green filamentous algae.

The genus was erected by Eaton (1873) for *angustella* (McLachlan) and *atra* (Hagen), the latter being transferred to *Stactobia* by McLachlan (1884). *O. tetensii* Kolbe was subsequently found by Neboiss (1963) to be a junior synonym of *Hydroptila costalis* Curtis (vide *Oxyethira*) and Flint (1966) showed *Clymene aegerfasciella* to be a senior synonym of *Orthotrichia americana* Banks.

The larva of *costalis* was described in detail by Nielsen and that of *angustella* by Jacquemart (1962b), although no distinguishing features were indicated in the latter work for separating the two species. It should be noted that Jacquemart's figure of the dorsal view of the head of *angustella* does not make it clear that the anterior beak is an extension of the labrum; it has also been drawn pointing in the opposite direction to that as figured by Nielsen.

Regarding the genera described by Ulmer (1951) from the Sunda Islands, larvae are described by Ulmer (1957) for *Orthotrichiella ranauana* and *Baliotrichia litoralis*. The relationships of these two genera, as well as that of *Javanotrichia*, with *Orthotrichia* are discussed below.

The following generic diagnosis is based on the literature and examination of adult and larval material in the BMNH collections.

DIAGNOSIS. *Adult.* Forewing length 2–4 mm; wings markedly attenuate, forewings with a row of black, flattened basal subcostal setae in males of the *angustella*-group: tentorium (Fig. 133) complete; antennae of 30–40 segments; postoccipital lobes prominent, subspherical, but not modified as scent-organs; ocelli 0: thorax (Fig. 133) – metascutellum characteristically rectangular: spur formula 0.3.4: ♀ genitalia a modified oviscapt (Fig. 134), segment VIII fused and sclerotized, segments IX and X membranous, IX short: ♂ genitalia (Fig. 135) characteristically asymmetrical; sternites VI and VII variously with ventral processes or tufts of setae; segment VIII unmodified; segment IX fused, often with asymmetrical, posterolateral processes; inferior appendages usually small and fused medially, but well developed, porrect and strongly curved in *costalis*; subgenital appendages indistinct or absent; bilobed process present (*Bp*); tergite X forming a large, asymmetrical dorsal plate, ventrally concave, often with laterally directed dorsal spines; beneath X is a variously shaped, slender, asymmetrical sclerite usually with two asymmetrical processes, one of which is long and slender and lies diagonally beneath X and alongside the aedeagus (according to Nielsen, 1970, a similar structure was described by Ulmer, 1951, for *Javanotrichia*, *Orthotrichiella* and *Sumatranotrichia*); aedeagus very long and slender with distinct proximal and distal halves near the junction of which arises a slender, spiral 'titillator'.

Larva (Fig. 136). Slightly depressed dorso-ventrally: dorsal ecdysial lines of head distinct; postmental sclerites and anterior ventral apotomes as in Fig. 28; labrum asymmetrical with a beak-like median process (Fig. 137); mandibles slender, flat, asymmetrical (Fig. 32): thoracic nota paired; mid- and hind-legs just slightly longer than forelegs; fore-tibia without a ventral process or modified setae; each tarsus with a distal, flattened, plate-like spur; fore-coxa with comb-like rows of setae; preepisternite of prothorax free; paired anal sternites present on all three thoracic venters, fused in prothorax (Fig. 42): abdomen cylindrical, slightly broader at midlength; segment II with a pair of lateral 'humps'; dorsal 'rings' present on segments III–VIII, segment I with a complete circle of 'rings' near anterior margin; tergite present on segment IX only; median caudal filament in early instars only.

Case (Fig. 138). Of the 'wheat-seed' type, almost circular in cross-section, tapering gradually towards slit-like anterior and posterior openings; convex dorsal surface characteristically ribbed, ventral surface flat.

Pupa. Typically hydroptilid but mandibles short; pupal case attached by a single attachment disc at each end.

BIOLOGY. The larvae prefer slowly running and sometimes almost stagnant water in plant thickets. According to Nielsen (1948) the larva bites into each cell of a filament of green algae and enlarges the hole by inserting the labral beak; the cell contents are then sucked out. This is a more efficient mechanism than that found in *Agraylea*, *Hydroptila* and *Oxyethira*. In addition there have been two reports (Burton & McRae, 1972; Disney, 1973) of *Orthotrichia* larvae feeding on *Simulium* (Diptera) larvae, but it was not evident as to whether these were cases of active predation or of the hydroptilids mistaking the *Simulium* for algal filaments.

SPECIES-GROUPS (see checklist). The 36 species may be split into four main groups on the basis of the form of the male genitalia.

The *angustella*-group: exclusively 'Old World' with the majority of representatives being recorded from the regions of Africa and SE. Asia (the latter region may include the species originally described by Ulmer, 1951, in *Javanotrichia*, *Baliotrichia* and *Orthotrichiella* from Indonesia, see group 2); *angustella* is the only truly Palaearctic representative and has a very wide distribution extending from northern Europe (including the British Isles) to northern Africa and from Iberia to the Urals; the group is characterized by the development of the lateral processes of segment IX in the males and the row of subcostal scales on the forewings of the males of most species.

The *litoralis*-group: the species mentioned above from Indonesia originally described by Ulmer (1951; 1957) as *Javanotrichia*, *Baliotrichia* and *Orthotrichiella* may form a distinct group; it also includes species described by Schmid (1958a) from Sri Lanka.

The *costalis*-group: a small 'Old World' group; *costalis* is the most common species and has a wide European distribution (including the British Isles) and has also been recorded from the Sudan, U.S.S.R. and Japan; the group is distinguished by the absence of lateral processes on segment IX and the small, more or less symmetrical inferior appendages in the males.

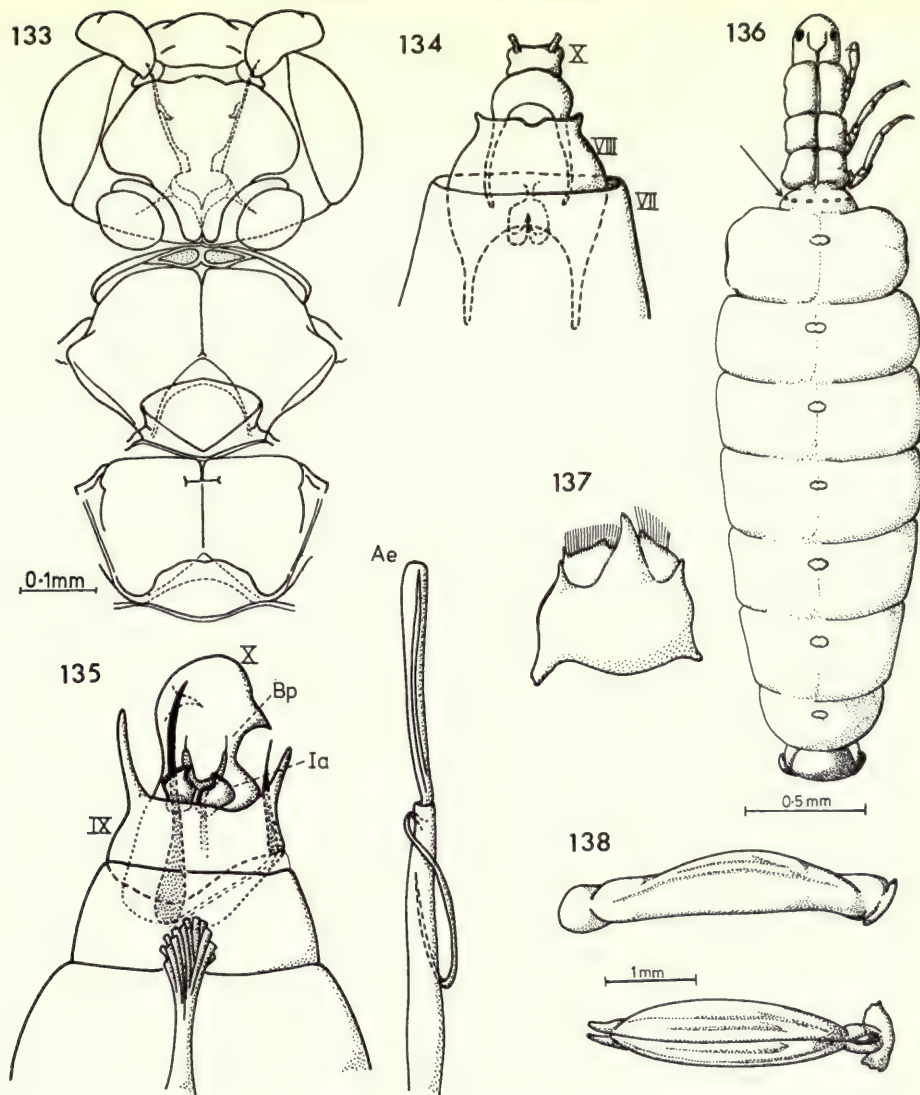
The *aegerfasciella*-group: principally Nearctic in distribution with one well-established Palaearctic representative (*tragetti*); the group is characterized by the lateral development of the asymmetrical inferior appendages of the males.

A fifth group may also be recognized.

The *kokodana*-group: this consists of two distinct species from Papua New Guinea characterized by the simplicity of the male genitalia. (N.B. there are unassociated ♀ specimens of *Orthotrichia* spp. from Fiji and Borneo in the BMNH collections.)

GENERIC SYNONYMS. The genera discussed below are here considered to be junior synonyms of *Orthotrichia*.

Javanotrichia Ulmer contains three species, *maeandrica* Ulmer and *curvata* Ulmer from Indonesia and *dampfi* Ulmer from Egypt. Ulmer (1951) distinguished the genus from *Orthotrichia* solely on venational characters but, as can be seen from other adult features such as the absence of ocelli, spur formula 0.3.4 and the distinctive asymmetrical form of the male genitalia in *Javanotrichia*, these two genera are probably synonymous. Examination of type-material (UHZIM loan) reveals that the structure of the thorax of *J. curvata* is typical of *Orthotrichia*; in addition the male genitalia are very similar to those of *O. avicularis* Kimmins from India. *J. dampfi* greatly



Figs 133–138 *Orthotrichia*. 133, adult head and thorax, dorsal view; 134, generalized ♀ genitalia, ventral view; 135, generalized ♂ genitalia, ventral view and aedeagus (vide Figs 15, 16); 136, larva, dorsal view; 137, larval labrum, dorsal view; 138, pupal case, lateral and dorsal views.

resembles other African *Orthotrichia* species, such as *O. benguelensis*, especially with respect to the spinose lateral processes of segment IX in the male. The immature stages are unknown.

Baliotrichia Ulmer contains *litoralis* Ulmer from Indonesia (Bali) and four species from Sri Lanka (Schmid, 1958a). As in *Javanotrichia* the genus is only distinguished on minor venational features. According to Schmid (1958a) the male genitalia of *B. udawarama* bear a 'curious similarity' to those of *O. extensa* Martynov from India while, in my opinion, the genitalia of *B. litoralis* are most like those of *O. avicularis* Kimmins. The larva and case of *B. litoralis*, as described by Ulmer (1957), are unmistakably those of *Orthotrichia* and thus, taking both adult and larval features into account, I propose that *Baliotrichia* be placed as a synonym of *Orthotrichia*.

Orthotrichiella Ulmer is a monotypic genus from Indonesia again only distinguished from *Orthotrichia* on minor venational features. Examination of type-material (UHZIM loan) indicates

that the two genera are synonymous and this is supported by the appearance of the immature stages described by Ulmer (1957).

In conclusion these three small tropical genera provide a natural geographical link with the *Orthotrichia* species from the mainland and New Guinea, this genus being previously unrecorded from the Indonesian region.

DISCUSSION. The genus *Orthotrichia* is a specialized and very successful recent member of the Hydroptilinae with a wide continuous present-day distribution. It is the only hydroptilid genus which has a truly tropical component (cf. the Stactobiini which, although tropical, are confined to the relict cool montane areas of SE. Asia and Africa) and probably owes its success to its tolerance of still water conditions and its specialized, efficient larval feeding habits.

Genus *ITHYTRICHIA* Eaton

Ithytrichia Eaton, 1873 : 139. Type-species: *Ithytrichia lamellaris* Eaton, by original designation and monotypy.

Saranganotrichia Ulmer, 1951 : 83. Type-species: *Saranganotrichia decussata* Ulmer, by original designation and monotypy. **Syn. n.**

DISTRIBUTION. Holarctic.

Ithytrichia is a small genus at present containing only four species. *I. lamellaris* is the most common Palaearctic species while *clavata* Morton, originally described from North America, was found by Tjeder (1930) to occur in Sweden and has since been recorded from France, Great Britain and Finland (Karelia) and may prove to be the only hydroptilid with a truly Holarctic distribution (cf. *Agraylea multipunctata* which may involve a species complex). *I. mazon* Ross from Illinois is known only from the holotype male while *bosniaca* Botosaneanu, a Yugoslavian species described from the immature stages only, is regarded as a doubtful species by Botosaneanu (1967).

The larva of *lamellaris* has been described several times, the most detailed account being given by Nielsen (1948). That of *clavata* has not positively been identified although the larva referred to by Needham (1902) and figured by Ross (1944), as well as that described by Wiggins (1977), is probably this species.

Saranganotrichia decussata Ulmer from Indonesia (Java) is known from both the adult and larval stages (Ulmer, 1951 and 1957 respectively) of which the latter show distinct affinities with *Ithytrichia* in the form of the case, larval head shape and possession of abdominal 'buds'. However, the male genitalia of *Saranganotrichia* are atypical of *Ithytrichia* and thus cast doubts on the associations of the adults and larvae. Examination of Ulmer's specimen of *decussata* (adult) failed to reveal any diagnostic characters as the microscopical preparation was in a very poor condition. Nevertheless, on the basis of the affinities of the larval stages, it is proposed here that *Saranganotrichia* be placed as a synonym of *Ithytrichia* until the true identity of the adults is discovered.

The following generic diagnosis is based on the literature and on examination of material in the BMNH collections.

DIAGNOSIS. *Adult.* Forewing length 3 mm: tentorium complete (Fig. 139); antennae with 20–25 segments; ocelli 3: thorax (Fig. 139) with mesoscutellum with anterior margin convex, posterior edge separated from posterior margin of mesonotum by a narrow strip; metascutellum with a strongly convex anterior margin: spur formula 0.3.4: abdominal sternite V with typical setate processes, although shorter than usual and in a faintly sculptured pit (Fig. 14): ♀ genitalia an oviscap, segment VIII with median ventral sclerite: ♂ genitalia distinct (Fig. 140); sternite VI sometimes with a short ventral spine; segments VI and VII unmodified; IX and X membranous dorsally, former incomplete ventrally but with lateral sides tapering posteriorly ('side-pieces' (Tjeder, 1930)) and with a hook-like structure arising ventrally near the apex; in *lamellaris* tergite X bears two characteristic parallel rod-like sclerites; inferior appendages slender, arising from antero-ventral margin of segment IX and extending to its lateral apex; subgenital plate with short postero-medial processes bearing short setae and attached basally to the apical hooks of IX; aedeagus long, well developed, with distinct proximal and distal halves divided by a median constriction by which arises the spiral 'titillator'.

Larva (Fig. 141). Head broad with slight median lateral bulges in region of 'eyes', flattened, tapering anteriorly both dorso-ventrally and laterally: dorsal ecdysial lines distinct; postmental sclerite hemispherical, ventral apotome V-shaped, prominent (Fig. 24); labrum long and narrow, curved sides tapering anteriorly, anterior margin of sclerite with three shallow indentations, narrow anterior membranous portion with straight anterior margin; mandibles very flat (even more so than in *Orthotrichia*, cf. Fig. 32), left with short lower blade, serrated upper blade and median brush, apices of both mandibles pointed with a small basal tooth on upper blade: pleurites of prothorax only with three distinct sclerites; prothoracic venter with unpaired anal sclerite (as in *Orthotrichia*) with lateral ends fused with posterior corners of nota (Fig. 42); median oral sternites present on meso- and metathoracic venters only: legs short, subequal, forelegs without trochanteral, femoral or tibial processes; fore-coxae with comb-like rows of setae: abdomen greatly compressed laterally, segment I very small, II with large lateral processes, III-VI with characteristic dorsal and ventral 'bud-like' processes, VII with dorsal process only, VIII with postero-ventral projection; segment I with complete circle of dorsal 'rings'; IX with tergite which projects 'roof-like' above anal prolegs (fused to X) and covering the base of the single median caudal filament.

Case (Fig. 142). This consists of secretion only and resembles a pumpkin seed; narrow anteriorly with an oval ridged opening flanked by the lateral valves, 'slit' only open medially. The thorax of the larva may be extended through the narrow anterior opening and, due to the ability of the thorax and first abdominal segment to rotate on the rest of the abdomen, the case is usually carried horizontally (cf. the lateral compression of the abdomen). Consequently, the ventral surface of the case is slightly more convex while the anterior ventral margin is slightly indented so that the hindlegs may be held free of the case.

Pupa. Typical; mandibles long, without teeth. The pupal case is sealed and held, with the ventral side towards the substrate, by a single median posterior filament with a broad attachment disc, and an anterior cylindrical plug which also broadens into a single attachment disc.

BIOLOGY. According to Lepneva (1964) the larvae of *lamellaris* prefer running water, brooks and rivulets in plant thickets while Nielsen (1948) records them as being distinctly rheophilous, occurring in the strong current on exposed parts of submerged vegetation and smooth, current-swept stones, the cases being held flat against the substrate. I. D. Wallace (pers. comm.) has collected *Ithytrichia* larvae (probably *lamellaris*) from amongst willow roots in fine silt along with larvae of an *Orthotrichia* species. According to Ulmer (1957) the larvae and pupae of *S. decussata* occur in flowing water amongst moss and leaves, in waterfalls, spring-channels and mountain brooks.

Although Nielsen (1948) did not observe the feeding behaviour of *lamellaris* larvae, he considers them to be detritus-feeders unlike the specialized algal-feeding larvae of *Orthotrichia* to which *Ithytrichia* is supposed to be allied. The flattened labial lobe may be adapted to serve as a shovel for scooping up diatoms and other detritus from the substrate, the food then being conveyed to a groove on the ventral surface of the labrum along which it passes to the pharynx. Nielsen considers the anterior tapering of the head to be associated with such feeding habits while the flattened pointed mandibles, although apparently not adapted for scraping or scooping, may be derived from the *Orthotrichia*-like condition (cf. Fig. 32), their function being taken over by the labium.

INCERTAE SEDIS

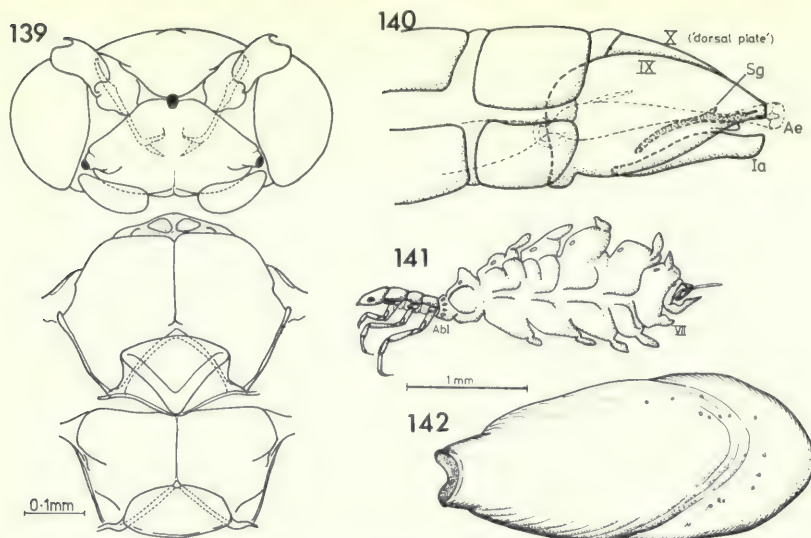
The following group of essentially monotypic and geographically distinct genera have not been assigned to any particular tribe due to the inadequacy of the existing data, the insufficiency or unavailability of well-preserved material or, as in the case of *Caledonotrichia* and *Dibusa*, the unique morphological features which cannot be likened to those of any other hydroptilid genus. All would, however, appear to be members of the subfamily Hydroptilinae; *Caledonotrichia* and *Dibusa* have typically hydroptilid larvae while all have hydroptilid adult features except *Dicaminus* which is known from the larval cases only. *Electrotrichia* is only known from Baltic Amber and appears to be a distinct but now extinct genus.

Genus *MACROSTACTOBIA* Schmid

Macrostactobia Schmid, 1958a : 46. Type-species: *Macrostactobia elawalikanda* Schmid, by original designation and monotypy.

DISTRIBUTION. Sri Lanka.

This monotypic genus is known only from the original series from Sri Lanka, of which there



Figs 139–142 *Ithytrichia*. 139, adult head and thorax, dorsal view; 140, generalized ♂ genitalia, lateral view (vide Figs 15, 16); 141, larva, lateral view; 142, larval case, lateral view.

is a single paratype male in the BMNH collections. The adult diagnosis given below is based on Schmid (1958a), the main characteristic being the unique form of the male genitalia. The larvae are unknown.

DIAGNOSIS. *Adult*. Forewing length 2.5–3.0 mm; head without large postoccipital lobes; antennae 18-segmented; ocelli 3: mesoscutellum subtriangular (BMNH specimen): ♂ genitalia with sternites VII and VIII very narrow; sternite IX enlarged ventrally but not invaginated into the preceding segments; segment X of two distinct halves; inferior appendages complex and fused along their midlength; aedeagus a long narrow tube.

BIOLOGY. The species is reported to inhabit 'rivers at moderate altitudes'.

DISCUSSION. Schmid places *Macrostactobia* at the base of the *Macrostactobia*–*Parastactobia*–*Plethus*–*Chrysotrichia* branch (of the Stactobiini), its primitiveness being indicated by its more complete wing venation and its relatively larger size. The genitalia are stated to exhibit the typical (stactobiine) characters of the group, the line of evolution resembling that of *Parastactobia* as suggested by the great development of segment IX at the expense of those preceding, and the long and rigid appendages.

The male genitalia are unique but while the antennae are of 18 segments only, as is typical of the Stactobiini, the metathorax does not have the rectangular form characteristic of this tribe. Consequently I can give no positive indications as to the true affinities of this very specialized monotypic genus but can merely stress the need for the examination of additional material.

Genus *DIBUSA* Ross

Dibusa Ross, 1939 : 66. Type-species: *Dibusa angata* Ross, by original designation and monotypy.

DISTRIBUTION. U.S.A. (N. Carolina, Tennessee, Arkansas, Kentucky, Oklahoma).

This North American genus is known only from the type-species. Ross (1939) first described the male and the larva has since been described by Wiggins (1977). The form of the male genitalia is unique within the Hydropsilidae but the associated larvae show unequivocally that *Dibusa* is a true member of the family. The following generic diagnosis is based on Ross (1939; 1944) and Wiggins (1977) and examination of larvae (USNM loan).

DIAGNOSIS. *Adult*. Forewing length 5.5 mm: head and antennae unmodified; ocelli 0; wing venation relatively complete, wings elliptical, ovate; spur formula 1.3.4: ♂ genitalia with segment IX retracted into

eighth, with sclerotized sides and a membranous dorsum; tergite X fused with IX, divided into a pair of lateral sclerotized plates separated on the meson by membranous folds and curved downward at the apex to form a short hook; the 'cerci' arise as a small lobe in the middle of the lateral margin at the base of tergite X; inferior appendages biramous, ventral lobe slightly enlarged and upturned at apex, dorsal lobe more slender, out-curved and widest at middle; aedeagus with a filiform basal portion, markedly enlarged near base, and a semimembranous irregularly tapering pointed apex.

Larva (Figs 143, 144), after Wiggins (1977). Head suboval in lateral view (i.e. not compressed): distinctly paired thoracic nota on all segments; pleurites fused on all thoracic segments; legs short, subequal, robust; tarsal claws unique being stout and strongly curved with a thick, blunt spur basally on each (but smaller than that of *Stactobiella*, cf. Figs 144 and 80); abdomen moderately distended, not markedly depressed or compressed, intersegmental grooves distinct; abdominal tergites present only on segment IX; dorsal 'rings' present on segments I–VIII; anal prolegs fused to segment X.

Case (Fig. 145). Typically 'purse-like', of two adpressed silken valves covered with pieces of the red freshwater alga *Lemanea*.

BIOLOGY. The larvae collected by Neff and Resh (Wiggins, 1977) were associated with the red freshwater alga *Lemanea*, the pupal cases being attached to the base of the algal thallus.

DISCUSSION. The relationships of *Dibusa* are not clear because no material was available for an examination of the diagnostic features of the adult head and thorax. However, from the general features of the adults, larvae and cases, *Dibusa* would appear to be a very specialized early offshoot of the tribe Hydroptilini. The relatively complete adult wing venation and the generalized form of the larva with its 'purse-type' case are very primitive features whereas the absence of ocelli, the unique male genitalia and the larval associations with *Lemanea* (and not the usual, more common green filamentous algae as in the Hydroptilini) indicate specialization. The more primitive features are suggestive of affinities with *Agraylea* (Hydroptilini) and *Nothotrichia* (*incertae sedis*) (vide Flint, 1967b).

Genus *NOTHOTRICHIA* Flint

Nothotrichia Flint, 1967b : 56. Type-species: *Nothotrichia illiesi* Flint, by original designation and monotypy.

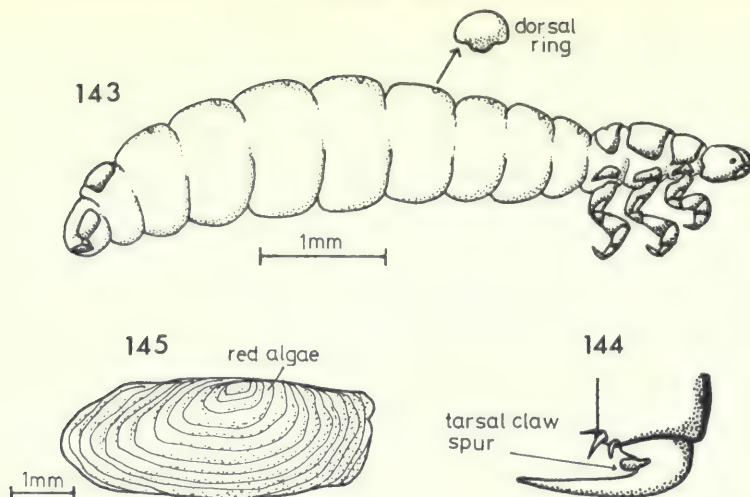
DISTRIBUTION. South America (Chile).

This monotypic genus has so far been recorded only from Chile, the type being collected in the Cautin Province in 1957 by Professor J. Illies with further specimens being taken by Flint and Cekalovic in 1966.

Flint (1967b) provides the basis of the generic diagnosis given below which is supplemented by observations on the head and thoracic structure as seen in a female specimen of *illiesi* (USNM loan). The larval stages are unknown.

DIAGNOSIS. *Adult.* Forewing length 3.5 mm: head and antennae unmodified; ocelli 3; wings not markedly narrowed but with pointed apices; venation relatively complete; spur formula 1.3.4: thorax (Fig. 146); mesoscutellum without transverse suture, anterior margin strongly convex; metascutellum deep, subquadrate, but with strongly convex anterior angles: ♂ genitalia (after Flint, 1967b) with segment IX incomplete dorsally, with a broad flap from dorsal angles; tergite X membranous, posterior margin trilobate; inferior appendages broad, large, 'mitten-like', with a small baso-dorsal 'thumb'; aedeagus with slightly expanded apex and apico-lateral process arising at midlength and contiguous with the central aedeagal duct, non-spiral 'titillator' present.

DISCUSSION. This unique endemic Chilean genus may represent a descendant of an early offshoot of the Hydroptilini branch which evolved in isolation in this part of the Neotropical region. This is indicated by the relatively complete venation, presence of 3 ocelli, presence of a fore-tibial spur, an undivided mesoscutellum and the non-spiral 'titillator' of the aedeagus. The male genitalia appear to be derived from the basic hydroptilid form but are specialized in that they are greatly simplified. Discovery of further species and the immature stages may give some insight into the true relationships of this genus.



Figs 143–145 *Dibusa angata* Ross. 143, larva, lateral view; 144, larval tarsus, lateral view; 145, larval case, lateral view.

Genus *DICAMINUS* Müller

Dicaminus Müller, 1879a : 39. Type-species: *Diaulus ladislavii* Müller, by subsequent monotypy.

Diaulus Müller, 1879c : 142. Type-species: *Diaulus ladislavii* Müller, by monotypy. [Synonymized by Fischer, 1961.]

DISTRIBUTION. South America (Brazil).

Müller (1879a) described a number of caddis cases from Brazil amongst which were some very distinct forms which had two dorsal 'chimneys' and were covered in diatoms. Müller considered these to belong to hydroptilid larvae and described them under the generic name of *Dicaminus* (Latin: of two chimneys), although neither a description of the larva nor a species name were given. In subsequent papers Müller (1879c; 1880) refers to these cases as being of the hydroptilid *Diaulus ladislavii*, thus naming the species and giving *Diaulus* (the Greek equivalent of *Dicaminus*) as the generic name. As stated by Fischer (1961), *Dicaminus* takes priority over *Diaulus* and consequently receives its type-species.

The following description of the cases is from Müller (1879c).

DESCRIPTION. The strongly laterally compressed oval cases have slit-like anterior and posterior openings and are covered in diatoms. On the dorsal margin they bear two (rarely three) cylindrical chimneys which facilitate the passage of water through the case without, according to Müller, the incessant exertions of the larva as seen in other hydroptilids where the case simply has slits at either end. The pupal cases are fixed vertically along their whole ventral margin to the upper side of stones 'and often these little houses form large villages of a rather picturesque aspect'. The larval case is reported to be 2.5 mm long by 0.75 mm broad.

DISCUSSION. The relationships and validity of this genus are not known since only the cases of the immature stages have been described. Müller's original material, which has not yet been traced, may contain larvae and pharate adults which will permit a more positive identification.

Genus *ORPHNINOTRICHIA* Mosely

Orphnino-trichia Mosely, 1934 : 138. Type-species: *Orphnino-trichia maculata* Mosely, by original designation and monotypy.

DISTRIBUTION. Australia (New South Wales).

The holotype of this endemic Australian genus is the only known specimen and it is in such a

poor condition (BMNH collection, slide mount) that details of the genitalia and thorax cannot be interpreted clearly.

Mosely erected the genus on the basis of the unique wing venation while the male genitalia also appear to be unlike those of any other hydroptilid genus. Since the thoracic structure, female genitalia and larval stages are unknown, the genus cannot be placed with any certainty at present. However, from the simplicity of the male genitalia and the form of the aedeagus, with its distinctive spiral 'titillator', the genus may have affinities with the Hydroptilini, differing from *Hydroptila* in the possession of ocelli, the absence of cephalic scent-organs and venation, and from *Oxyethira* in venation and spur formula.

DIAGNOSIS. *Adult.* Forewing length 2.75 mm: tentorium incomplete; antennae 32-segmented; ocelli 3: spur formula 0.2.4: ♂ genitalia with sternite VII bearing a short spinous process; segment VIII unmodified; segment IX fused, deeply excised dorsally, appearing bifurcate from above and containing the membranous tergite X which tapers posteriorly to a pointed apex; subgenital plate not distinguishable unless it is fused with or replaces the 'inferior appendages'; 'inferior appendages short but slender, fused along almost entire mid-line except for a short distance apically (this structure may represent the subgenital plate, the inferior appendages being absent or vestigial as the two small medio-ventral processes of segment IX); aedeagus with a broad proximal region separated from the longer more slender distal region by a median constriction just anterior to which arises the spiral process or 'titillator'.

Genus *CALEDONOTRICHIA* Sykora

Caledonotrichia Sykora, 1967 : 585. Type-species: *Caledonotrichia illiesi* Sykora, by original designation.

DISTRIBUTION. New Caledonia.

This small endemic New Caledonian genus contains two species, *illiesi* and *minor*, both described by Sykora (1967) from material collected in 1966 by Professor J. Illies. I have been able to examine adult, larval and pupal material of unidentified and undescribed species of *Caledonotrichia* kindly loaned to me by Professor H. H. Ross of Athens, Georgia.

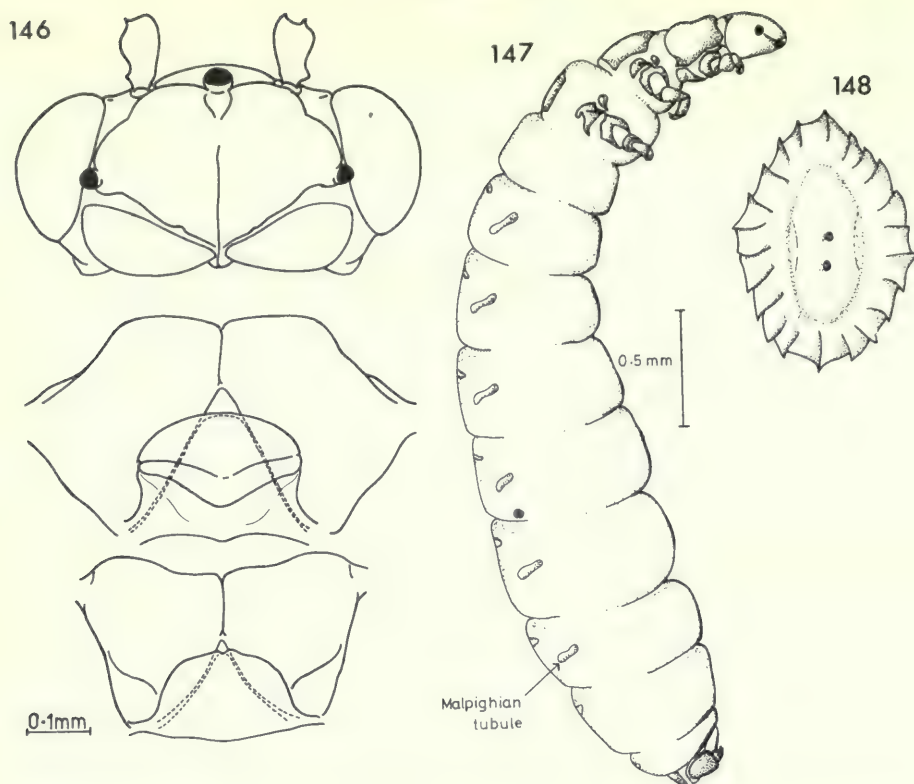
The genus is unique within the Hydroptilidae with respect to the very distinctive male genitalia, the corresponding parts of which, as noted by Sykora, are difficult to homologize with those of any other genus. The following diagnosis is based on Sykora (1967) and examination of Ross's material (the larvae have not previously been described).

DIAGNOSIS. *Adult.* Forewing length 2.5–3.0 mm: head unmodified; tentorium complete; antennae c. 30-segmented: wings elongate, tapering to narrow apex; base of forewing with costal area thickened with a dense fringe of black androconia, oval patch of androconia between Cu_1 and Rs in centre of wing (males): mesoscutellum without transverse suture: spur formula 0.3.4: ♀ genitalia an oviscapt: ♂ genitalia characterized by the inferior appendages ('claspers' (Sykora, 1967)) which are 'bean-shaped' with dorsal and ventral lobes; 'subgenital plate' of Sykora with two long rods; tergite X short, membranous; aedeagus simple, long, rod-like.

Larva (Fig. 147). Head relatively short, wide posteriorly, narrowing anteriorly; 'postmental sclerites' difficult to interpret, but apparently U-shaped: body somewhat compressed dorso-ventrally: thorax widest at segment III; mid- and hind-legs held out more to side than in, for example, *Hydroptila*; legs short, subequal; tibia of each leg with a short apico-ventral process bearing two stout, blunt spines; tarsal claw very small, hook-like; preepisternite free on all segments, epimeron of each apparently fused; single pair of anal sternites present on prothoracic venter only: abdomen not greatly distended, tapering slightly back from metathorax; intersegmental grooves distinct; dorsal 'rings' present on segments II–VIII; in dorsal view the Malpighian tubules can be seen just under the abdominal cuticle, one pair passes along the abdomen laterally and has a distinct loop in each of segments II–VII (possibly having some special osmoregulatory or excretory function?); tergite IX present; anal prolegs fused to sides of segment X.

Case (Fig. 148). This consists of secretion only and is dorso-ventrally compressed with a central tubular section (in which the larva lives) surrounded by a folded lateral fringe by which the case is probably fixed to the substrate. The central region has two small dorsal holes (possibly to aid water circulation) and the whole case characteristically 'curls up', at least in fluid-preserved specimens.

BIOLOGY. There are no data available on this subject but, from the general appearance of the larva and its case, the genus would seem to be associated with fast-running water habitats (case fixed and flattened).



Figs 146–148 Incertae sedis. 146, *Nothotrichia*, adult head and thorax, dorsal view. 147–148, *Caledonotrichia*; (147) larva, lateral view; (148) case, dorsal view.

DISCUSSION. *Caledonotrichia* is a very distinct hydroptilid genus both with respect to the adult and immature stages, neither of which provide any clues as to the relationships of the group. It would appear to have evolved in complete isolation on the island of New Caledonia to which it is endemic.

Genus *ELECTROTRICHIA* Ulmer

Electrotrichia Ulmer, 1912a : 42. Type-species: *Electrotrichia subtilis* Ulmer, by monotypy.

DISTRIBUTION. Baltic Amber (therefore possibly Eocene, of western Palaearctic origin).

This genus is known from specimens of the type-species in Baltic Amber only; no material was available for examination. From Ulmer's original description (ocelli present; spur formula 0.3.4; forewing length 2.0–2.6 mm; male genitalia figured) it is impossible to place the genus with any certainty within the Hydroptilidae, although the narrow tapering wings and spur formula suggest that it may have affinities with the Hydroptilinae.

Phylogeny of the Hydroptilidae

The family Hydroptilidae may be derived from a primitive glossosomatid-like ancestor early in the evolutionary history of the Trichoptera. Unlike the typical glossosomatids which construct a primitive 'saddle-type' transportable case, the larvae of these early hydroptilid ancestors probably adopted the more advanced type of 'purse-like' case. This basic ancestral stock then appears to have given rise to two distinct lines which have resulted in the present-day subfamilies, the Ptilocolepinae and the Hydroptilinae. The former retained primitive adult features similar to those of the other Rhyacophiloidea, especially the Glossosomatidae, while the latter evolved the more characteristic form associated with present day adult Hydroptilidae.

The larvae of the Ptilocolepinae have retained the basic form of the hypothetical generalized hydroptilid and in addition they exhibit the primitive, cool montane habitat preferences supposedly shown by the early, ancestral Trichoptera. Thus the Ptilocolepinae are now restricted to cool springs in shaded forest regions in the mountainous areas of western Europe and North America. In the Hydroptilinae, on the other hand, the present-day success of the subfamily may be due to the adaptive radiation of the larval stages into a wide variety of freshwater aquatic habitats. These range from springs and seeps to the larger, moderately flowing rivers and streams. Certain groups have become structurally, behaviourally and physiologically adapted for living in conditions requiring specialized modifications. These include the splash zones of waterfalls and rapids, exposed substrates in the more rapid sections of rivers and streams and, at the other extreme, vegetation thickets in slowly moving to almost static, larger bodies of water.

An early member of the ancestral Hydroptilinae stock possibly gave rise to two, or perhaps three, subsidiary evolutionary lines. The first led to the Stactobiini and possibly also the Leuco-trichiini, although it is more likely that the latter arose from a distinct, but closely related, ancestor. The second line eventually radiated into the Ochrotrichiini, Neotrichiini, Hydroptilini and Orthotrichiini which appear to have diverged relatively more recently but which have each undergone such remarkable larval morphological modifications in relation to habitat specialization that the larvae at least are quite distinct. A study of both fundamental adult and larval characters has revealed a number of basic relationships between the four last mentioned tribes which, although not yet fully satisfactorily resolved, are suggestive of the following evolutionary pathways.

The early ancestors of the second (third ?) branch of the Hydroptilinae may have given rise to two distinct and independent Nearctic–Neotropical tribes, the Ochrotrichiini and the Neotrichiini. This may have occurred before the larvae adopted associations with green filamentous algae as is typical of the remaining two tribes, the Hydroptilini and the Orthotrichiini. The latter tribe would appear to be the most advanced tribe since the larvae are highly specialized algal feeders, at least in *Orthotrichia*, and are often capable of tolerating stagnant and polluted conditions.

The relationships of the genera and generic groups within each tribe have been discussed in the relevant sections of the systematic account. The evolutionary steps have been summarized in Chart II.

Genera here transferred from the Hydroptilidae

As a result of a study of all genera previously attributed to the Hydroptilidae the following three small, geographically restricted groups are considered to belong to other Trichopteran families as indicated.

Padunia Martynov, 1910 (= *Uenotrichia* Tsuda, 1942); to GLOSSOSOMATIDAE: PROTOPTILINAE.

Tsukushitrichia Kobayashi, 1964; possibly a synonym of *Kibuneopsychomyia* Tsuda, 1942; to PSYCHOMYIIDAE.

Petrotrichia Ulmer, 1910; possibly related to the primitive, unplaced African genera *Petrothrincus* Barnard and *Hydrosalpinx* Barnard.

Material examined: *Padunia* spp. (loaned from the Lepneva collection, ZI); *Petrotrichia palpalis* Ulmer, paratypes, BMNH; the transfer of *Tsukushitrichia* is based on a study of the original description and figures, material being unavailable for study.

Genus *PADUNIA* Martynov (Glossosomatidae: Protoptilinae)

Padunia Martynov, 1910 : 425. Type-species: *Padunia adelungi* Martynov, by monotypy.

Uenotrichia Tsuda, 1942 : 228. Type-species: *Uenotrichia fasciata* Tsuda, by monotypy. [Synonymized by Fischer, 1971.]

DISTRIBUTION. Asia (central and eastern U.S.S.R.; Korea).

This small Asian genus contains four species described by Martynov from the U.S.S.R. (*adelungi*, *forcipata*, *lepnevae* and *bikinensis*) and one from Korea originally described as *Uenotrichia fasciata* Tsuda. Fischer (1971) synonymized these two genera but wrongly gave preference to *Uenotrichia* since *Padunia* clearly should have date priority.

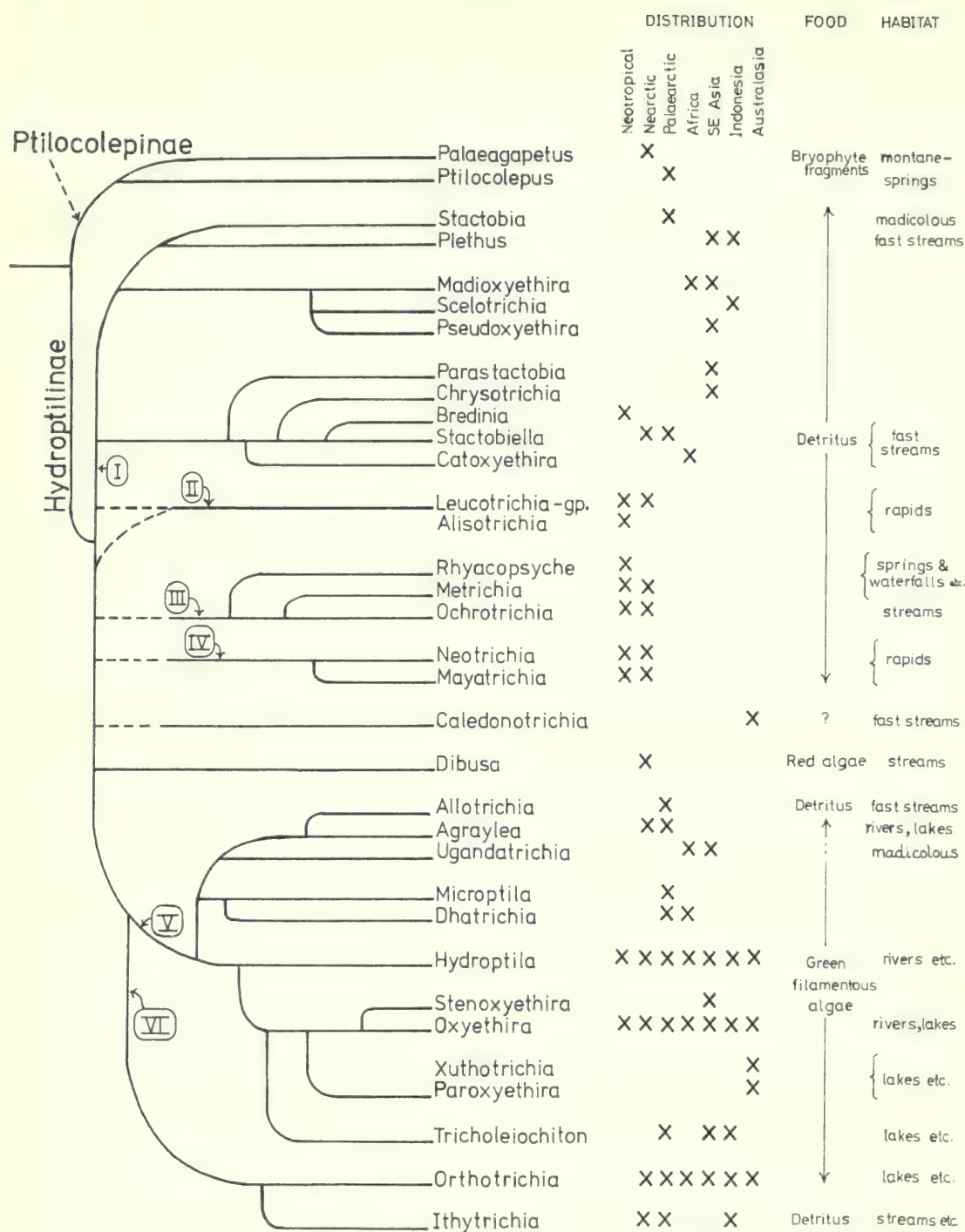


Chart II The phylogeny of the Hydroptilidae: generic relationships (I, Stactobiini; II, Leucotrichiini; III, Ochrotrichiini; IV, Neotrichiini; V, Hydroptilini; VI, Orthotrichiini).

Examination of adult features indicates that *Padunia*, especially with respect to the structure of the thorax, the male genitalia and the shape and venation of the wings, is closely related to *Matrioptila* Ross and *Nepaloptila* Kimmins, primitive members of the Protoptilinae (Glossosomatidae) from the SE. United States and SE. Asia respectively. Figs 149, 150 show the resemblance of the head and thorax of *Padunia* to those of *Nepaloptila*.

In 1954, Mosely transferred *Mortoniella* Ulmer, *Protoptila* Banks, *Mexitrichia* Mosely, *Canoptila* Mosely and *Antoptila* Mosely, which are essentially Neotropical genera, from the Hydroptilidae to the Glossosomatinae, then a subfamily of the Rhyacophilidae. Subsequently, Ross (1956) elevated the group, with the inclusion of *Culoptila* Mosely, to the subfamily Protoptilinae within the Glossosomatidae, at the same time erecting the genus *Matrioptila* for a single primitive species originally described in *Protoptila*.

Representatives of the Protoptilinae occur from southern Canada to central Chile and the subfamily now contains the following additional genera: *Campsiophora* Flint, *Cariboptila* Flint, *Mastigoptila* Schmid, *Merionoptila* Schmid and *Tolhuaca* Schmid. The description of *Nepaloptila* Kimmins (1964) from a single Nepalese species furnished the first Palaearctic record of this subfamily and this may now be supported by this discovery of the true identity of *Padunia* Martynov.

Ulmer (*in litt.* to Mosely, *vide* Mosely, 1954) suggested that *Padunia* might also belong with the *Protoptila*-group but, possibly due to not having any material to study, Mosely did not transfer it with the others. He did, however, remark upon its more primitive venation (and its resemblance to *Antoptila*) which is now substantiated if this character is compared with those of *Matrioptila* and *Nepaloptila* which are both considered to be the more primitive members of the Protoptilinae. Ross (1956) considered the subfamily to have originated in the New World due to the occurrence there of *Matrioptila*, but this theory may now need to be modified on account of the discovery of the equally primitive genera *Nepaloptila* and *Padunia* in the Old World. The possibility that *Matrioptila* and *Padunia* were derived from New World ancestors which passed into Asia, however, cannot be ruled out. The immature stages of *Padunia* are unknown.

Genus *TSUKUSHITRICHIA* Kobayashi (Psychomyiidae)

Tsukushitrichia Kobayashi, 1964 : 211. Type-species: *Tsukushitrichia forficula* Kobayashi, by monotypy.

DISTRIBUTION. Japan.

Kobayashi originally described this monotypic genus in the Hydroptilidae but stated that it was unique within the family on account of its atypical spur formula (2.4.3), the structure of the fifth abdominal segment and the wing venation. In addition ocelli are absent, the fifth segment of the maxillary palp is long and flexible and the male genitalia are quite unlike those of any other hydroptilid.

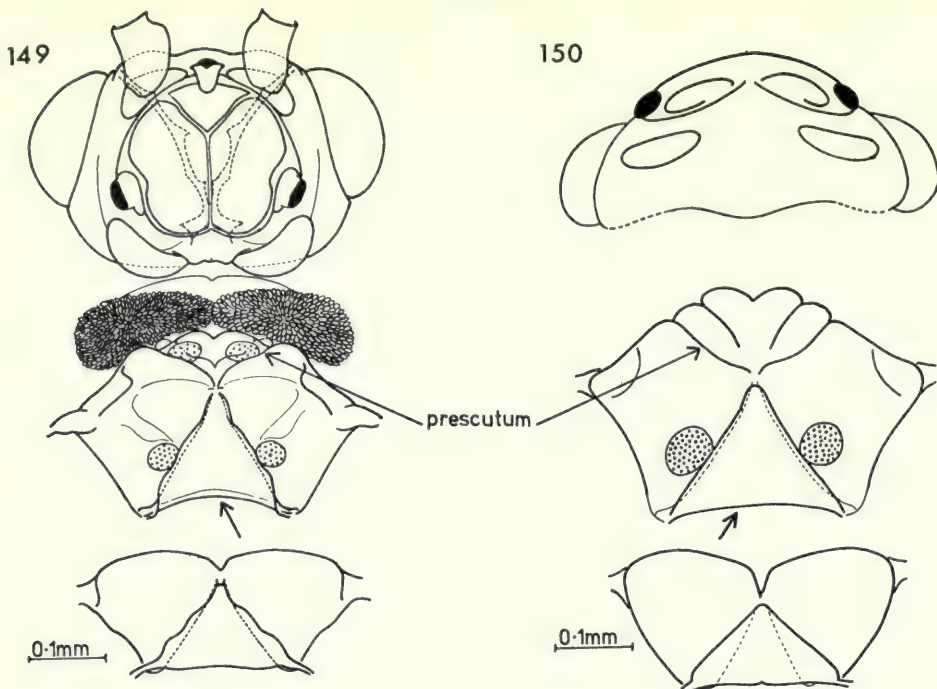
If the spur formula is considered to be derived from the combination 2.4.4, the species keys out in Ross (1944) to the family Psychomyiidae, very close to the genus *Psychomyia* especially with respect to the wing venation and the distinctive elongate fifth segment of the maxillary palp, the latter always being proportionately shorter in the Hydroptilidae. Of the known species of Japanese psychomyiids, *Kibuneopsychomyia kibuneana* Tsuda bears most resemblance to *T. forficula*, both in the venation, which is almost identical, and the general aspect of the male genitalia. It is thus proposed that the genus *Tsukushitrichia* be transferred from the Hydroptilidae to the Psychomyiidae where it may be synonymous with the genus *Kibuneopsychomyia* Tsuda. Examination of material would be necessary to confirm these propositions. Neither the immature stages of *Tsukushitrichia* nor *Kibuneopsychomyia* are known.

Genus *PETROTRICHIA* Ulmer

Petrotrichia Ulmer, 1910 : 43. Type-species: *Petrotrichia palpalis* Ulmer, by monotypy.

DISTRIBUTIONS. Seychelles.

This isolated monotypic genus is known only from the original series of males and females from



Figs 149–150 Glossosomatidae, Protoptilinae, adult head and thorax. 149, *Nepaloptila*; 150, *Padunia*.

the Seychelles, the immature stages being unknown. Examination of paratype material in the BMNH indicates that this genus is definitely not a member of the Hydroptilidae, in which it was originally placed, although difficulty has been encountered in assigning it to its proper family.

The adult features are as follows: head without ocelli or postoccipital warts; basal antennal segment elongate; maxillary palpi (male and female) 5-segmented (cf. Ulmer, 1910); spur formula originally stated to be 0.2.4 but a minute spur has been detected on the fore-tibia, hence 1.2.4; mesothorax elongate (cf. Hydroptilidae), mesoscutellum ovoid, with a short distance between posterior margins of mesoscutellum and notum; metascutellum elongate, subtriangular; wings with rounded apices (slightly tapered); abdominal sternite V without lateral setate processes or sternal ridge; ♂ tenth segment fused, with a pair of parallel, tapering, ventro-lateral processes (= fused inferior appendages), dorsal cerci each with a short median process and longer lateral baso-ventral processes, aedeagus 'fan-like'.

Following Scott's (1967) key to South African caddis-flies, *Petrotrichia* keys out with *Hydrosalpinx* Barnard and *Petrothrincus* Barnard which have been placed in the Beraeidae and Molanidae respectively. The head and thorax of *Petrotrichia* accord well with those of *Molanna flavicornis* as figured by Wiggins (1968 : 11, Fig. 12). Professor H. H. Ross (pers. comm.) is at present studying the relationships of *Hydrosalpinx* and *Petrothrincus* which may prove, at least in the case of the latter, to be primitive relict Trichoptera so far found only in the southern African continent. Ross agrees (pers. comm.) that it is possible that *Petrotrichia* might be a beraeid or a small molannid, especially with respect to the 'weird dorsal processes (cerci)' and the venation. Discovery of the immature stages would greatly aid in establishing the relationships of these genera.

Although such a conclusion is very unsatisfactory, it is proposed that *Petrotrichia* should be removed from the Hydroptilidae, on the basis of the great differences in the structures of the head, antennae, thorax, abdominal segment V and the male genitalia, and that it should be grouped, for the time being, with *Hydrosalpinx* and *Petrothrincus*.

Checklist of species of Hydroptilidae

(* indicates material examined; † indicates fossil species)

Family HYDROPTILIDAE Stephens

Subfamily PTILOCOLEPINAE Martynov

Genus *PTILOCOLEPUS* Kolenati

- **colchicus* Martynov
- **extensus* McLachlan
- **granulatus* (Pictet)
- dilatatus* Martynov
- turbidus* Kolenati
- villosus* Navás

Genus *PALAEAGAPETUS* Ulmer

- **celsus* Ross
- guppyi* Schmid
- nearcticus* Banks
- †*rotundatus* Ulmer

Subfamily HYDROPTILINAE Stephens

Tribe STACTOBIINI Botosaneanu

STACTOBIA-groupGenus *STACTOBIA* McLachlan

- Afrित्रichia* Mosely
- Aratríchia* Mosely
- Lamonganotrichia* Ulmer syn. n.

furcata-group

- **algira* Vaillant
- **atra* (Hagen)
- **beatensis* Mosely
- **caspersi* Ulmer
- decostrai* Jacquemart
- **eatoniella* McLachlan
- oredonensis* Mosely
- eretziána* Botosaneanu & Gasith
- freyi* Nybom
- **furcata* Mosely

fuscicornis Schneider sensu
McLachlan, 1884 (partim)

- **fuscicornis* (Schneider)
- obscura* (Kolenati)

jacquemarti Malicky

- **kimminsi* Schmid
- **maculata* Vaillant
- **malacantosa* Schmid

margalitana Botosaneanu

- **mclachlani* Kimmins
- botosaneanui* Schmid
- delamerei* Coineau & Jacquemart
- fuscicornis* Schneider sensu
McLachlan, 1884 (partim)

monnioti Jacquemart

- **moselyi* Kimmins
- eatoniella* McLachlan sensu
Mosely
- fuscicornis* Schneider sensu
McLachlan

nybomi Schmid

- atra* (Hagen) sensu Morton
- atra* (Hagen) sensu Nybom
- atra* (Hagen) sensu Schmid

storai Nybom*martynovi*-group

- **dohleri* Schmid
- fischeri* Schmid
- **forsslundi* Schmid
- klapaleki* Schmid
- marlieri* Schmid
- **martynovi* Schmid
- **mayeri* Schmid
- olgae* Martynov
- **quadrípina* Kimmins
- **schmidi* Kimmins
- **tjederi* Schmid
- ulmeriana* Schmid
- urania* Malicky

nielsenii-group

- bolzei* Jacquemart
- **crassa* (Ulmer) comb. n.
- **fahjia* (Mosely)
- moretti* Schmid
- **nielsenii* Schmid
- radavanovici* Schmid
- risiana* Schmid

vaillanti-group

- **aurea* (Mosely)
- **vaillanti* Schmid

Incertae sedis

- japonica* Iwata
- mallorcensis* Vaillant (nomen nudum)
- megalatlantica* Vaillant (nomen nudum)

Genus *PLETHUS* Hagen

- Plethotrichia* Ulmer syn. n.
- **acutus* Ulmer
- amogawarsa* Schmid
- **baliana* (Ulmer) comb. n.
- **bodikatuwa* Schmid
- cilamegha* Schmid
- cruciatu* Ulmer
- **cursitans* (Hagen)
- kala* Schmid

usawasadenna Schmid

**vajhrobodhi* Schmid

STACTOBIELLA-group

Genus **STACTOBIELLA** Martynov

Tascobia Ross

biramosa-group

biramosa Martynov

**palmata* (Ross)

ulmeri-group

delira (Ross)

**ulmeri* (Siltala)

risi (Felber)

brustia-group

brustia (Ross)

Genus **BREDINIA** Flint

dominicensis Flint

Genus **CHRYSOTRICHIA** Schmid

**aranuwa* Schmid

badhami Schmid

**dotalugola* Schmid

hapitigola Schmid

**hatnagola* Schmid

Genus **PARASTACTOBIA** Schmid

talakalahena Schmid

Genus **CATOXYETHIRA** Ulmer

Sperotrichia Marlier **syn. n.**

**fasciata* Ulmer

formosae (Iwata)

**improcera* Statzner

mali (Marlier) **comb. n.**

**ocellata* Statzner

**pinheyi* Kimmins

veruta Morse

MADIOXYETHIRA-group

Genus **MADIOXYETHIRA** Schmid

**marshalli* Statzner

**milinda* Schmid

**nepalensis* Kimmins

trifurcata (Jacquemart) **comb. n.**

Genus **PSEUDOXYETHIRA** Schmid

asgiriskanda Schmid

Genus **SCELOTRICHIA** Ulmer

**saranganica* Ulmer

Tribe **LEUCOTRICHINI** Flint

LEUCOTRICHIA-group

Genus **LEUCOTRICHIA** Mosely

melleopicta-group

chiriquiensis Flint

gomezi Flint

**limpia* Ross

**melleopicta* Mosely

tubifex Flint

viridis Flint

pictipes-group

fairchildi Flint

imitator Flint

pictipes (Banks)

sarita Ross

Genus **ZUMATRICHIA** Mosely

multisetosa-group

multisetosa Flint

galtena-group

antilliensis Flint

attenuata Flint

bifida Flint

chiriquiensis Flint

diamphidia Flint

echinata Flint

**galtena* Mosely

notosa (Ross)

saluda Flint

strobilina Flint

vieja Flint

filosa-group

caudifera Flint

**filosa* Mosely

rhampoides Flint

teapa Flint

palmaria-group

anomalopectera Flint

palmaria Flint

Genus **PELTOPSYCHE** Müller

maclachlani Müller

**sieboldii* Müller

Genus **ANCHITRICHIA** Flint

spangleri Flint

Genus **COSTATRICHIA** Mosely

simplex-group

simplex Flint

spinifera Flint

lodora-group

bipartita Flint

**lodora* Mosely

panamensis Flint

tripartita Flint

Genus **ACOSTATRICHIA** Mosely

brevipenis Flint

fimbriata Flint

**plaumanni* Mosely

**simulans* Mosely

spinifera Flint

Genus **BETRICHIA** Mosely

argentinica Flint

bispinosa Flint

occidentalis Flint

surinamensis Flint

**zilbra* Mosely

Genus **ABTRICHIA** Mosely

**antennata* Mosely

**squamosa* Mosely

Genus **CELAENOTRICHIA** Mosely

**edwardsi* Mosely

ALISOTRICHIA-groupGenus **ALISOTRICHIA** Flint

argentilinea Flint
blantoni Flint
chorra Flint
dominicensis Flint
hirudopsis Flint

lobata Flint
orophila Flint
quemada Flint
septempunctata Flint
tamaza Flint
trifida Flint
wirthi Flint

Tribe **OCHROTRICHIINI** trib. n.Genus **OCHROTRICHIA** Mosely*Polytrichia* SibleySubgenus **OCHROTRICHIA**

**aldama* (Mosely)
alexanderi Denning & Bickler
alsea Denning & Bickler
**anisca* (Ross)
argentea Flint & Bickler
arizonica Denning & Bickler
**arranca* (Mosely)
**arva* (Ross)
attenuata Flint
brayi Flint
buccata Denning & Bickler
caimita Flint
caligula Flint
capitana Ross
chiapa Denning & Bickler
confusa (Morton)
**contorta* (Ross)
cruces Flint
dactylophora Flint
denningi Bickler & Morse
eliaga (Ross)
escoba Flint
felipe Ross
filiforma Flint
flagellata Flint
gurneyi Flint
hadria Denning & Bickler
ildria Denning & Bickler
**insularis* Mosely
intermedia Flint
lobifera Flint
**logana* (Ross)
**lometa* (Ross)
lucia Denning & Bickler
marica Flint
**mono* (Ross)
moselyi Flint
nacora Denning & Bickler
okanogensis Flint
oregona (Ross)
pacifica Flint
palitla Flint
panamensis Flint
pectinata Flint
pectinifera Flint
phenosa Ross
ponta Flint

potomus Denning
provosti Bickler
quadrispina Denning & Bickler
riesi Ross
rothi Denning & Bickler
shawnee (Ross)
spinosa (Ross)
spinosissima Flint
spinulata Denning & Bickler
**stylata* (Ross)
susanae Flint & Herrmann
tagala Flint
tarsalis (Hagen)
**tenanga* (Mosely)
**trapoiza* Ross
**unio* (Ross)
verda Flint
vertreesi Denning & Bickler
weddleae Ross
wojcickiyi Bickler
xena (Ross)
zioni Denning & Bickler

Subgenus **METRICHIA** Ross

Argentitrichia Jacquemart syn. n.
aberrans Flint
argentinica Schmid
arizonensis Flint
biungulata Flint
bulbosa (Jacquemart) comb. n.
campana Flint
continentalis Flint
dietzi Flint
exclamationis Flint
juana Flint
lemniscata Flint
neotropicalis Schmid
nigritta Banks
penicillata Flint
quadrata Flint
similis Flint
trigonella Flint
warema Flint
yalla Flint

Genus **RHYACOPSYCHE** Müller

hagenii Müller
mexicana (Flint)
obliqua Flint
torulosa Flint
turrialbe Flint

Tribe NEOTRICHINI Ross

Genus *NEOTRICHIA* Morton

Cyllene Chambers
Exitrichia Mosely
Dolotrichia Mosely
Guerrotrichia Mosely
Lorotrichia Mosely
collata-group
alata Flint
**anahua* (Mosely)
collata Morton
**digitata* (Mosely)
elerobi Blickle
**eroga* (Mosely)
ersitis Denning
**esmalda* (Mosely)
**exicoma* (Mosely)
falca Ross
heleios Flint
interrupta Flint
iridescens Flint
minutisimella (Chambers)
**notuena* (Mosely)
**novara* (Mosely)
numii Ross
okopa Ross
**olorina* (Mosely)
osmena Ross
**ovona* (Mosely)
**oxima* (Mosely)
panneus Denning
riegeli Ross
sonora Ross

**tertia* (Mosely)
vibrans Ross
ranea Denning
canixa-group
**canixa* (Mosely)
corniculans Flint
**dubitans* (Mosely)
**xicana* (Mosely)
caxima-group
**cameria* (Mosely)
**caxima* (Mosely)
costaricensis Flint
edalis Ross
rotundata Flint
hiaspa-group
halia Denning
**hiaspa* (Mosely)
kitae Ross
biuncifera-group
biuncifera Flint
bullata Flint
falcifera Flint
proboscidea Flint
unispina Flint
bifida-group
bifida Flint
lobata Flint
 Genus *MAYATRICHIA* Mosely
acuna Ross
**ayama* Mosely
ponta Ross
**rualda* Mosely

Tribe HYDROPTILINI Stephens

AGRAYLEA-groupGenus *AGRAYLEA* Curtis

argyricola Kolenati
**cognatella* McLachlan
costello Ross
drosima Navás
insularis (Hagen)
**multipunctata* Curtis
multiguttata Uljanin
signata Banks
flavida (Banks)
fraterna Banks
saltesea Ross
**sexmaculata* Curtis
pallidula McLachlan
flabellifera (Bremer) (partim)

†*spathifera* UlmerGenus *ALLOTRICHIA* McLachlan

†*ampullata* Ulmer
heterocera Navás
laerma Malicky

marinkoviciae Malicky
**pallicornis* (Eaton)
succinica Hagen
tauri Jacquemart
teldanica Botosaneanu
vilnensis Raciecka
 Genus *MICROPTILA* Ris
apsara Schmid
**bejela* Mosely
**indra* Schmid
**minutissima* Ris
 Genus *UGANDATRICHIA* Mosely gen. rev.
Moselyella Kimmins
nigra-group
**acuta* Mosely
africana (Marlier & Vaillant) comb. n.
**minor* Mosely
**nigra* Mosely
rhodesiensis Scott
violacea-group
**cyanotrichia* (Kimmins)

- **nikataruwa* (Schmid)
- roudra* (Schmid) **comb. n.**
- **sourya* (Schmid) **comb. n.**
- **violacea* (Morton)
- Genus **DHATRICHIA** Mosely
- **bipunctata* Statzner
- **inasa* Mosely

HYDROPTILA-group

- Genus **HYDROPTILA** Dalman
- Phrixocoma* Eaton
- Hydropneuma* Enderlein
- Hydroptilina* Martynov
- Oxydroptila* Martynov **syn. n.**
- Oeceotrichia* Ulmer **syn. n.**
- Pasirotrichia* Ulmer **syn. n.**
- Sumatranotrichia* Ulmer **syn. n.**
- sparsa-group**
- **acuta* Mosely
- **africana* Kimmins
- **angulata* Mosely
- **campanulata* Morton
- cintrana* Morton
- **cornuta* Mosely
- emarginata* Martynov
- friedeli* Malicky
- **fuentaldeala* Schmid
- **hochyangha* Schmid
- **lotensis* Mosely
- **simulans* Mosely
- **sparsa* Curtis
- uncinata-group**
- angulifera* Kumanski
- **fortunata* Morton
- juba* (Enderlein)
- insubrica* Ris
- kalonichtis* Malicky
- bureschi* Kumanski
- **stellifera* Morton
- **sylvestris* Morton
- **uncinata* Morton
- vichtaspa* Schmid
- capensis-group**
- calundoensis* Marlier
- **capensis* Barnard
- consimilis-group**
- **ajax* Ross
- albicornis* Hagen
- maculata* (Banks)
- transversa* Banks
- ancistrion* Flint
- **angusta* Ross
- antillarum* Flint
- arctia* Ross
- berneri* Ross
- broweri* Blickle
- **consimilis* Morton
- denza* Ross
- ditalea* Flint
- grenadensis* Flint

- **icona* Mosely
- latosa* Ross
- lloganae* Blickle
- martorelli* Flint
- medinai* Flint
- **melia* Ross
- **meralda* Mosely
- **mexicana* Mosely
- novicola* Blickle & Morse
- **paschia* Mosely
- **pecos* Ross
- **perdita* Morton
- **producta* Mosely
- pullatus* Denning
- quinola* Ross
- scolops* Ross
- strepha* Ross
- surinamensis* Flint
- tusculum* Ross
- valhalla* Denning
- veracruzensis* Flint
- occulta-group**
- **adana* Mosely
- **armata* Ross
- **cognata* Mosely
- **cruciata* Ulmer
- **gandhara* Schmid
- **hirra* Mosely
- **martini* Marshall
- occulta* (Eaton) **sensu auctt.**
- **occulta* (Eaton)
- insignis* Martynov
- **kimminsi* Mosely
- **parthava* Schmid
- palestinae* Botosaneanu & Gasith
- panchaoi* Schmid
- phaon* Malicky
- rhodica* Jacquemart
- kumanskii* Malicky
- **sanghala* Schmid
- **spatulata* Morton
- taurica* Martynov
- **vala* Ross
- **valesiaca* Schmid
- waskesia* Ross
- tineoides-group**
- amoena* Ross
- **ampoda* Ross
- callia* Denning
- fiskei* Blickle
- **hamata* Morton
- **perplexa* Mosely
- lennoxii* Blickle
- metoeca* Blickle & Morse
- **modica* Mosely
- moselyi* Ulmer
- remita* Blickle & Morse
- **rono* Ross
- spinata* Blickle & Morse

**tineoides* Dalman
femoralis (Eaton)
longispina McLachlan
tortosa Ross
wyomyia Denning
dikirilagoda-group
dikirilagoda Schmid
**kurukepitiya* Schmid
mitirigalla Schmid
losida-group
**bispina* Kimmins
**incertula* Mosely
**losida* Mosely
**tasmanica* Mosely
**triloba* Kimmins
pulchricornis-group
aegyptia Ulmer
**dampf* Ulmer
kurnas Malicky
phenianica Botosaneanu
**pulchricornis* Pictet
forcipata-group
**bifurcata* Mosely
**forcipata* (Eaton)
ivisa Malicky
vectis-group
**vectis* Curtis
corsicanus Mosely
maclachlani Klapálek
viganoi Botosaneanu
figurina-group
**cortensis* Mosely
tigurina Ris sensu Mosely
rheni Ris
**tigurina* Ris
waubesiana-group
**acadia* Ross
**delineata* Morton
nicoli Ross
salmo Ross
wakulla Denning
**waubesiana* Betten
xoncla Ross

Incertae sedis

acoma Denning
angustipennis (Martynov)
annulicornis Matsumura
**argosa* Ross
**armathai* Schmid
brincki Jacquemart
crenata (Ulmer) **comb. n.**
decia Etnier & Way
dentata Ross
dodgei Denning
elongata (Ulmer) **comb. n.**
eramosa Harper
fuentelarbola Schmid
furcata (Martynov) **comb. n.**
grandiosa Ross

gunda Milne
jackmanni Blickle
kirilawela* (Schmid) **comb. n.
lonchera Blickle & Morse
molsonae Blickle
pectinifera Schmid
†phileos Cockerell
**protera* Ross
sengavi Schmid
**serrata* Morton
simplex Nielsen (doubtful sp. acc.
 Nielsen, *in litt.*)
**touroumaya* Schmid
trilobata Jacquemart
trullata (Ulmer) **comb. n.**
usurigonis Matsumura
**virgata* Ross
xella Ross
xera Ross

OXYETHIRA-group

Genus *OXYETHIRA* Eaton

Lagenopsyche Müller
Argyrobothrus Barnard
Loxotrichia Mosely
Dampftrichia Mosely
Oxytrichia Mosely
falcata-group
boreella Svensson & Tjeder
delcourti Jacquemart
dentata Nybom
bidentata Nybom
**falcata* Morton
rhodani Schmid
fischeri Higler
**frici* Klapálek
**spinosella* McLachlan
flavicornis-group
**bogambara* Schmid
campanula Botosaneanu
ecornuta Morton
**flavicornis* (Pictet)
costalis (Curtis) sensu Eaton
sida Blickle & Morse
**tenuella* Martynov
**unidentata* McLachlan
fuentejalona Schmid
meridionalis Jacquemart & Coineau

rivicola-group

allagashensis Blickle
dualis Morton
**forcipata* Mosely
grisea Betten
lumosa Ross
**michiganensis* Mosely
novasota Ross
obscura Flint
obtatus Denning
rivicola Blickle & Morse
rossi Blickle & Morse

setosa Denning
sodalis Ross & Spencer
unispina Flint
simplex-group
galekoluma Schmid
**harpagella* Kimmins
paramartha Schmid
ramosa Martynov
angustella Martynov
**simplex* Ris
**tristella* Klapálek
distinctella-group
araya Ross
**distinctella* McLachlan
**sagittifera* Ris
**serrata* Ross
azteca-group
archaica Malicky
**azteca* (Mosely)
**dalmeria* (Mosely)
glasa (Ross)
janella Denning
neglecta Flint
puertoricensis Flint
**zilaba* (Mosely)
ulmeri-group
aculea Ross
arizona Ross
cirrifera Flint
tega Flint
**ulmeri* (Mosely)
zeronia-group
jamaicensis Flint
longissima Flint
macrosterna Flint
simulatrix Flint
verna Ross
walteri Denning
zeronia Ross
pallida-group
florida Denning
**maya* Denning
pallida (Banks)
cibola Denning

viminalis Morton
bidentata-group
abacatia Denning
aeola Ross
**bidentata* Mosely
mirabilis-group
flagellata Jacquemart
**mirabilis* Morton
Incertae sedis
**albiceps* McLachlan
anabola Blickle
angustella Martynov
berneri Etnier & Way
coercens Morton
hyalina (Müller)
incana Ulmer
spirogyrae (Müller)
**velocipes* (Barnard)
Genus *STENOXYETHIRA* Kimmins
Gnathotrichia Ulmer **syn. n.**
**excisa* Kimmins
isabellina* (Ulmer) **syn. n.
**minima* Kimmins
Genus *PAROXYETHIRA* Mosely
**eatoni* Mosely
**hendersoni* Mosely
hintoni Leader
kimminsi Leader
**tillyardi* Mosely
Genus *XUTHOTRICHIA* Mosely
**eskensis* Mosely
**fimbriata* Mosely
**ochracea* Mosely
**simplex* Mosely
Genus *TRICHOLEIOCHITON* Kloet & Hincks
Leiochiton Guinard
Synagotrichia Ulmer **syn. n.**
**fagesii* (Guinard)
felina (Ris)
flabellifera (Bremi) partim.
fortensis* (Ulmer) **comb. n.
**lacustris* Kimmins

Tribe ORTHOTRICHINI Nielsen

Genus *ORTHOTRICHIA* Eaton
Clymene Chambers
Javanotrichia Ulmer **syn. n.**
Orthotrichiella Ulmer **syn. n.**
Baliotrichia Ulmer **syn. n.**
angustella-group
**angustella* (McLachlan)
brunneicollis (Pictet) (partim)
**avicularis* Kimmins
barnardi Scott
benguelensis Marlier

damasi Marlier
dampfi (Ulmer) **comb. n.**
flagellum Marlier
indica Martynov
kivuensis Jacquemart
melitta Malicky
**moselyi* Tjeder
**sanya* Mosely
**spinicauda* Kimmins
straelini Jacquemart
verbeki Jacquemart

litoralis-group
**curvata* (Ulmer) comb. n.
guruluhela (Schmid) comb. n.
hinipitigola (Schmid) comb. n.
**litoralis* (Ulmer) comb. n.
**maeandrica* (Ulmer) comb. n.
medipitigola (Schmid) comb. n.
**ranauana* (Ulmer) comb. n.
udawarama (Schmid) comb. n.
costalis-group
**aequatoriana* Kimmins
alboguttata Jacquemart
**costalis* (Curtis)
tetensii Kolbe
extensa Martynov
aegerfasciella-group
**aegerfasciella* (Chambers)
**americana* Banks
dorsalis Banks
brachiata Morton

baldufi Kingsolver & Ross
**cristata* Morton
americana Betten
curta Kingsolver & Ross
instabilis Denning
**tragetti* Mosely
kokodana-group
**kokodana* Kimmins
**obscura* Kimmins
Incertae sedis
dentata Kingsolver & Ross
petiti Jacquemart
trilineata Jacquemart
Genus *ITHYTRICHIA* Eaton
Saranganotrichia Ulmer syn. n.
bosniaca Botosaneanu
**clavata* Morton
**decussata* (Ulmer) comb. n.
**lamellaris* Eaton
brunneicornis (Pictet) (partim)

INCERTAE SEDIS

Genus *MACROSTACTOBIA* Schmid
**elawalikanda* Schmid
Genus *DIBUSA* Ross
angata Ross
Genus *NOTHOTRICHIA* Flint
illiesi Flint
Genus *DICAMINUS* Müller
Diaulus Müller
ladislavii (Müller)

Genus *ORPHNINOTRICHIA* Mosely
**maculata* Mosely
Genus *CALEDONOTRICHIA* Sykora
**illiesi* Sykora
minor Sykora
Genus *ELECTROTRICHIA* Ulmer
†*subtilis* Ulmer

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E. G. Munroe & M. Shaffer

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A revision of *Vitessidia* Rothschild & Jordan and *Vitessa* Moore (Lepidoptera : Pyralidae)

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Synopsis

The genera *Vitessidia* Rothschild & Jordan and *Vitessa* Moore are revised and a new genus is described. Two species of *Vitessidia*, three species of *Cosmethella* gen. n., and twenty-eight species and sixteen subspecies of *Vitessa* are described, of which fifteen species and fourteen subspecies are new. One new synonym, two new status and two new combinations are established, eleven lectotypes are designated. Keys to the genera, species and subspecies are provided, the distributions of the species and subspecies are discussed and are illustrated with maps, and notes on the biology and descriptions of the immature stages are given for *Vitessa suradeva rama* Moore. Wing patterns and genitalia are illustrated for all species and subspecies, and for both sexes where available.

Introduction

This paper revises the classification of three genera of large, conspicuous and at least partly diurnal moths of the family Pyralidae (subfamily Pyralinae). Except for revisional notes on Endotrichini (Whalley, 1961; 1963), there has been no study of the inter-relationships of genera of the Pyralinae since Hampson (1869b), who used characters now known to be inadequate. The

three genera can now be defined as belonging to the Pyralinae from the following characters: chaetosema present; maxillary palpus present; proboscis well developed; fore wing with R_5 stalked with R_4 and R_3 ; hind wing with R_s not anastomosed with $Sc + R_1$ (Pyralini), or R_s anastomosed with $Sc + R_1$ (Endotrichini); median vein non-pectinated. According to the current definition of the Endotrichini, *Vitessidia* keys to this tribe, whereas *Cosmethella* and *Vitessa* key to the Pyralini. Certain features of the ♂ genitalia in *Vitessidia* appear to be endotrichine in character: the uncus is wide and flattened dorsoventrally, and distally bilobed in this genus, whereas in typical Pyralini, including *Cosmethella* and *Vitessa*, the uncus is single; the gnathos in *Vitessidia* has anteroventrally directed lateral arms and a strongly bifid medial element, as opposed to the transverse lateral arms and single, laterally compressed, blade-like medial element in *Cosmethella* and *Vitessa*. *Vitessidia*, however, differs from known Endotrichini, as well as from *Cosmethella* and *Vitessa*, in the following features: the eyes bear interfacetal hairs, a very unusual character in the Pyralidae; and R_5 separates from R_4 distal to the separation of R_3 , not basal to it as in Endotrichini and many Pyralini. In external features and in ♂ and ♀ genitalia, *Vitessidia* is not, however, closely related to any Endotrichini known to us at present, and we cannot place it in this tribe with any certainty. The genera *Cosmethella* and *Vitessa*, though typical of the Pyralini in most characteristics, have wing markings that are quite distinct from those of any other genera, and at present their generic relationship is uncertain. Because *Vitessidia* has been associated with *Vitessa* (including *Cosmethella*) in the generally accepted classification, and because their relationship has not previously been questioned, we think it useful to consider the genus in the present paper.

The life-history of this group is known through the work of T. R. Bell, who made manuscript notes on one species of *Vitessa*, and preserved larval and pupal exuviae. These are discussed under the genus *Vitessa* (p. 262) and under *Vitessa suradeva rama* (p. 322).

Geographically the genera extend to North India and Sri Lanka in the west, to Queensland, Australia, in the south, and to Fiji and Samoa in the east. All three genera occur in New Guinea; *Vitessidia* appears to be confined to that island. *Cosmethella* is represented also in the Solomon Islands; *Vitessa* occupies the whole range of the group but the largest concentration of species and species-groups is in the Papuan region. This pattern of distribution is consistent either with evolution in and radiation from a Papuan centre, or with radiation from an Asiatic centre, with outward displacement and secondary local radiation of successive ancestral stocks. The latter alternative would agree with the interpretation of Belkin (1962) for mosquitoes and the model of Wilson (1959) based on ants. The distribution of *Vitessa* is discussed in greater detail under the generic heading.

The colour patterns in these genera are striking and depart widely from those normal in the Pyralinae. The nature of the patterns and their boldness suggest that they may be mimetic or aposematic. There is indirect evidence that aposematism, Müllerian mimicry and Batesian mimicry may all occur among the genera considered. The hypothesis of mimicry is supported by the convergent resemblance of the moths to members of several different groups of Lepidoptera and other insects, some of them potential or possible models.

Considering first the genus *Vitessidia*, the resemblance is to ithomiine butterflies of the genus *Tellervo* Kirby (see Vane-Wright, 1971), with which other Lepidoptera of several families constitute a mimetic association, probably partly Müllerian, partly Batesian. The relative rarity of the two *Vitessidia* species as compared with the more abundant *Tellervo* butterflies suggests that the former may be Batesian mimics of the latter.

We have not investigated in detail the possible mimetic associates or models of *Cosmethella* species. The two rare New Guinea species are *Vitessa*-like in fore wing pattern and probably belong to the same mimetic groupings as members of that genus. The more common *Cosmethella unipectinalis*, from the Solomon Islands, is reminiscent of certain Homoptera, but the similarity has not been assessed under field conditions.

Vitessa species very closely resemble such Agaristidae as *Argyrolepidia megisto* (Boisduval) and its relatives. Certain Agaristidae are thought to be aposematic models in Africa (Guillaumin, 1976), but so far as we know this has not been demonstrated for *Argyrolepidia*. Munroe and Holland collected *Argyrolepidia* species in New Guinea at mercury-vapour light, but in a ratio

of abundance of only 1 : 100 to the similarly coloured *Vitessa* species. However, many Agaristidae are mainly diurnal, and this may well be true of *Argyrolepidia*. At least some *Vitessa* species are also diurnal in part. In India, T. R. Bell (manuscript notes in BMNH) recorded *V. suradeva rama* as flying in small numbers in the daytime at flowers of *Acanthocephalus indicus* Achille Richard (Myrsinaceae) in company with larger numbers of the hypsid moth *Macrobrochis gigas* Walker, which has only a very general resemblance to this *Vitessa*. Any mimetic association between these two species is presumably only of partial efficiency. Any advantages that arise from these resemblances between *Vitessa* species and Agaristidae most likely depend on selection by diurnal, visually searching predators. Such selection might be exercised as easily on resting moths as on active ones.

A number of other moths resemble *Vitessa* species and probably enter the same mimetic associations. *Tyspanodes hillalis* (Schaus), *celebensis* Munroe and *radiata* Kenrick, and *Nevrina procopia* (Stoll) (Pyrilidae : Pyraustinae) bear some resemblance to *Vitessa* species. *Heortia polypylagalis* Hampson and *dominalis* Lederer (Pyrilidae : Odontiinae; see Munroe, 1977) closely resemble species of the *Vitessa zemire*- and *griseata*-groups, whilst *Heortia vitessoides* (Moore) and *H. iridia* Munroe resemble species of *Vitessa* that have black and white hind wings. *Imma saturata* (Walker) (Immidae) resembles *Vitessa cyanea*.

As well as resembling other moths, *Vitessa* species have a general appearance much like that of some lycid beetles. This group is generally considered to be aposematic, and its species are thought to be mimicked by a number of other insects. However, Drs Henry F. Howden, P. J. Darlington Jr and J. Linsley Gressitt, all of whom are familiar with the Papuan beetle fauna, were unable to suggest likely beetle models in that geographical region.

We think it possible in view of their relative abundance, rather slow flight and somewhat leathery texture that *Vitessa* species are aposematic and that they may act as models or Müllerian co-mimics rather than as Batesian mimics. Snellen (1890 : 560) mentions a ♂ of *Vitessa suradeva* from the Naga Hills with a label stating that the anal tuft had a scent of bitter almonds. We have not located this specimen. Much stronger corroborative evidence will, of course, be required before we can firmly conclude that *Vitessa* species are aposematic.

Throughout the text wing measurements given are double the distance from wing apex to centre of thorax. Original altitude records from data labels have been converted from feet to metres and rounded to the nearest 50 metres except in the cases of very low altitudes.

Abbreviations of museums, institutions and collections

ANIC	Australian National Insect Collection, C.S.I.R.O., Canberra, Australia.
BPBM	Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.
BMNH	British Museum (Natural History), London, U.K.
CAS	California Academy of Sciences, San Francisco, California, U.S.A.
CNC	Canadian National Collection, Biosystematics Research Institute, Agriculture Canada, Ottawa, Canada.
CM	Carnegie Museum, Pittsburgh, Pennsylvania, U.S.A.
CMAG	City Museum & Art Gallery, Birmingham, U.K.
CU	Cornell University, Ithaca, New York, U.S.A.
HI	Private collection of H. Inoue, Iruma City, Saitama Prefecture, Japan.
KRS	Koronivia Research Station, Nausori, Fiji.
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, U.S.A.
MM	Manchester Museum, Manchester, U.K.
MNHN	Muséum National d'Histoire Naturelle, Paris, France.
NMNH	National Museum of Natural History, Washington, D.C., U.S.A.
NMNZ	National Museum of New Zealand, Wellington, N.Z.
RNH	Rijksmuseum van Natuurlijke Historie, Leiden, Netherlands.
RSM	Royal Scottish Museum, Edinburgh, U.K.
TM	Transvaal Museum, Pretoria, South Africa.
UM	Übersee-Museum, Bremen, West Germany.
UM	University Museum, Oxford, U.K.
ZM	Zoologisk Museum, Copenhagen, Denmark.

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Dr H. F. Howden of Carleton University, Ottawa, Dr P. J. Darlington Jr and Dr J. Linsley Gressitt advised on possible coleopterous models for *Vitessa* species. Dr P. E. S. Whalley, British Museum (Natural History), initiated the studies for this present paper and continued giving valuable advice and criticism during its preparation. Dr K. Sattler, British Museum (Natural History), also made many useful suggestions.

We are indebted to our colleagues in Ottawa and London for their comments and advice.

Species transferred from *Vitessa*

Vitessa pyraliformis Walker, 1864 : 220 (Oxford Type no. 546; UM, Oxford) [examined], not *Vitessa pyraliata* Walker, 1864 : 220, though so misinterpreted by Ragonot (1891 : 646). Transferred to the family Agaristidae by Swinhoe (1892 : 159); now regarded as a synonym of *Argyrolepidia megisto* Boisduval, 1832.

Vitessa triplaga Walker, 1869 : 8 (holotype ♂ in BMNH) [examined]. Transferred to the subfamily Pyraustinae as a synonym of *Heortia dominialis* Lederer, 1863, by Hampson (1898 : 751). Later transferred to the subfamily Odontiinae by Munroe (1977 : 436).

Check-list of genera, species-groups, species and subspecies

VITESSIDIA Rothschild & Jordan, 1905

diaphana Rothschild & Jordan, 1905

geometrina sp. n.

COSMETHELLA gen. n.

unipectinalis (Hampson, 1906) comb. n.

minor sp. n.

major sp. n.

VITESSA Moore, [1860]

Cosmethis sensu auct. nec Hübner, [1820]

griseata-group

griseata Kenrick, 1907

brandti sp. n.

talboti (Janse, 1924) comb. n.

nobilis sp. n.

zemire-group

cyanea ceramensis subsp. n.

cyanea cyanea Hampson, 1906

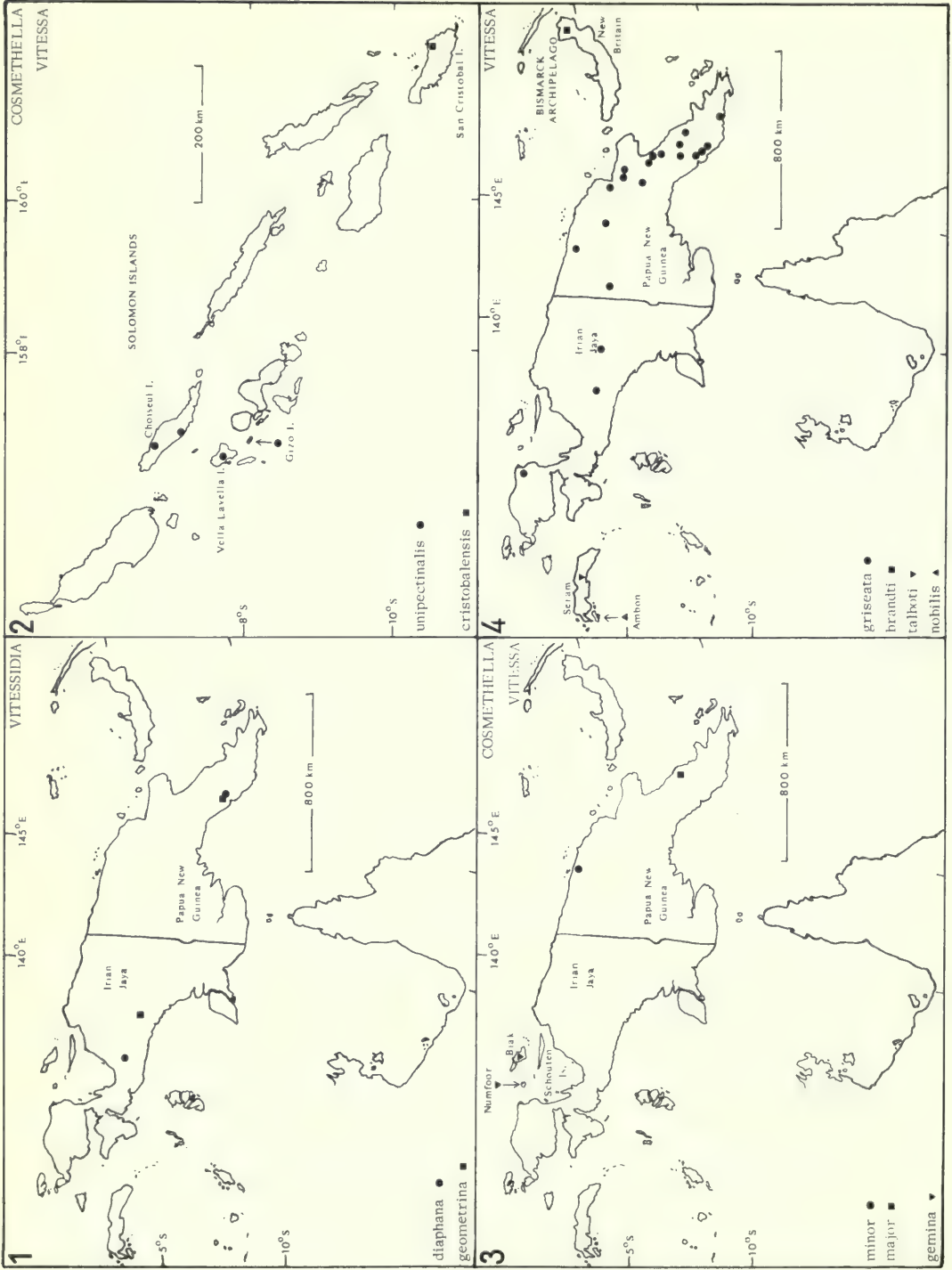
- zemire expansa* subsp. n.
zemire zemire (Stoll, 1782)
zemire temerata Swinhoe, 1906 stat. n.
zemire nephritica subsp. n.
zemire coronis subsp. n.
zemire novaebritanniae subsp. n.
zemire solomonis subsp. n.
zemire cheesmanae subsp. n.
vitialis Hampson, 1906
tamsi sp. n.
hieratica-group
hieratica Swinhoe, 1900
stettina-group
philippina sp. n.
stettina Swinhoe, 1906
hollandi wallacealis subsp. n.
hollandi hollandi subsp. n.
hemiallactis-group
ternatica Lederer, 1863
sarumensis Holland, 1900 syn. n.
hemiallactis moluccana subsp. n.
hemiallactis hemiallactis Meyrick, 1887
hemiallactis admiralitatis subsp. n.
hemiallactis lustrans subsp. n.
intermedia sp. n.
barretti sp. n.
glaucoptera Hampson, 1906
cristobalensis sp. n.
pyraliata-group
nicobarica Hampson, 1896
pyraliata latialbata subsp. n.
pyraliata triangulifera subsp. n.
pyraliata pyraliata Walker, 1864
kolakalis sp. n.
sulaensis sp. n.
muluana sp. n.
gemina sp. n.
splendida Schultze, 1908
plumosa-group
plumosa plumosa Hampson, 1896
plumosa salayerensis subsp. n.
suradeva-group
teleroma Swinhoe, 1906
suradeva suradeva Moore, [1860]
formosa Felder & Rogenhofer, 1874
suradeva rama Moore, 1885 stat. n.

Key to genera

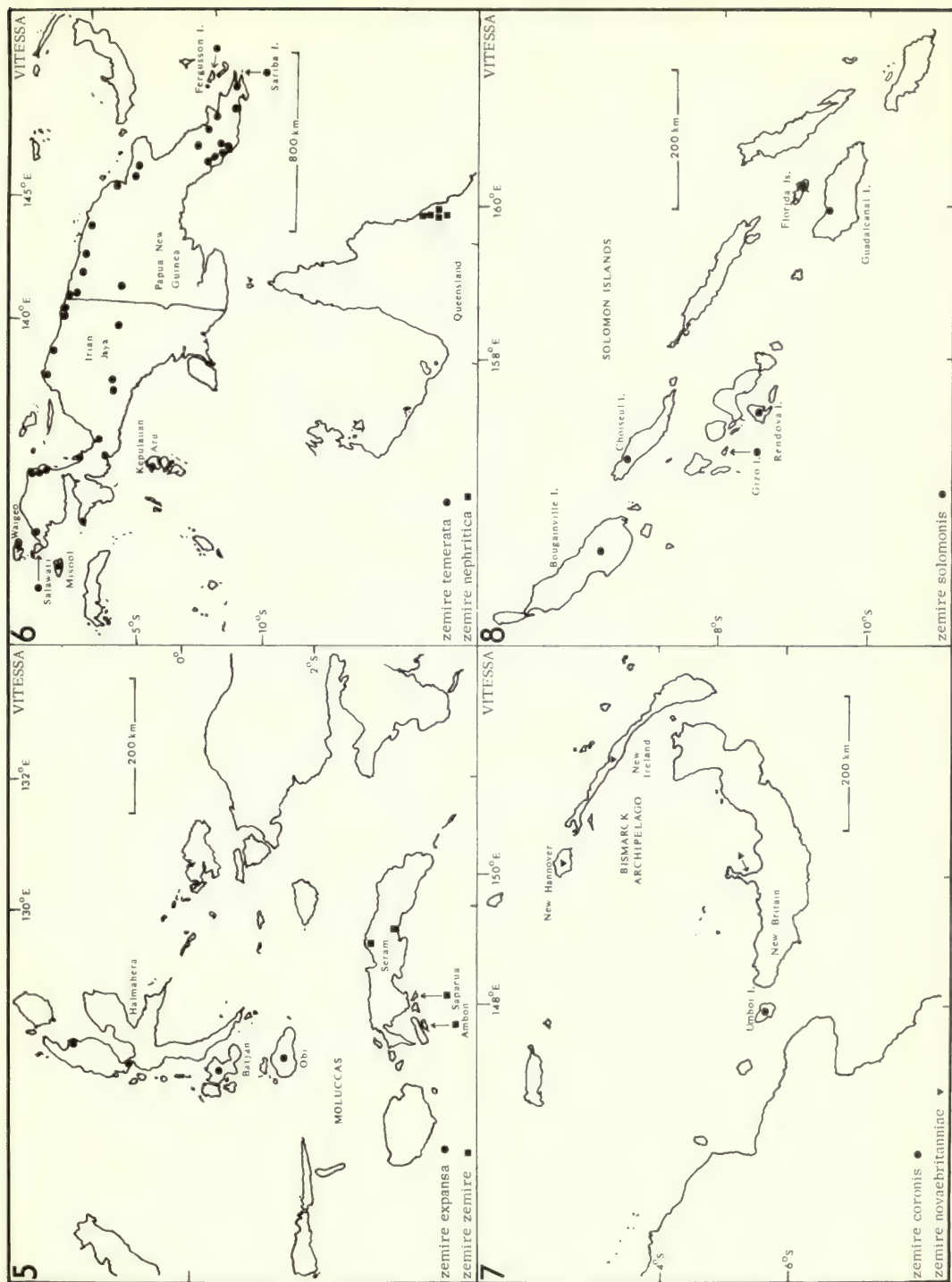
- 1 Antenna simple, either ciliated or pilose, weakly compressed, its length more than three-quarters that of fore wing; fore wing with discocellular vein at centre strongly angled toward base *VITESSIDIA* (p. 245)
- Antenna laminate, unipectinate or bipectinate, its length less than three-quarters that of fore wing; fore wing with discocellular vein at centre not strongly angled toward base 2
- 2 Antenna unipectinate in both sexes; fore wing with R_2 stalked with R_{3+5} *COSMETHELLA* (p. 254)
- Antenna bipectinate in ♂, laminate in ♀; fore wing with R_2 arising from cell *VITESSA* (p. 258)

VITESSIDIA Rothschild & Jordan, 1905

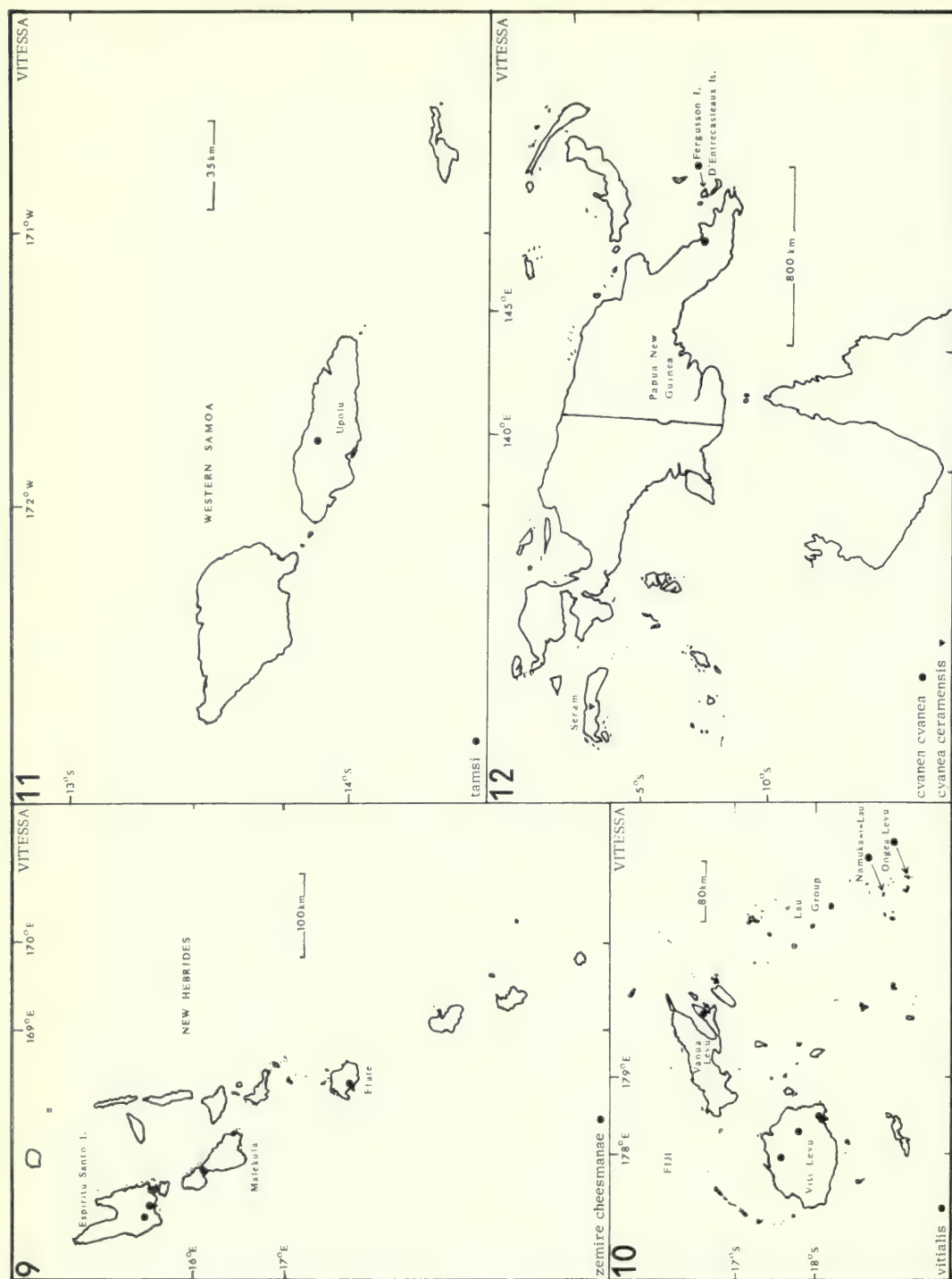
Vitessidia Rothschild & Jordan, 1905, *Novit. zool.* **12** : 475. Type-species: *Vitessidia diaphana* Rothschild & Jordan, 1905, by original designation and monotypy.



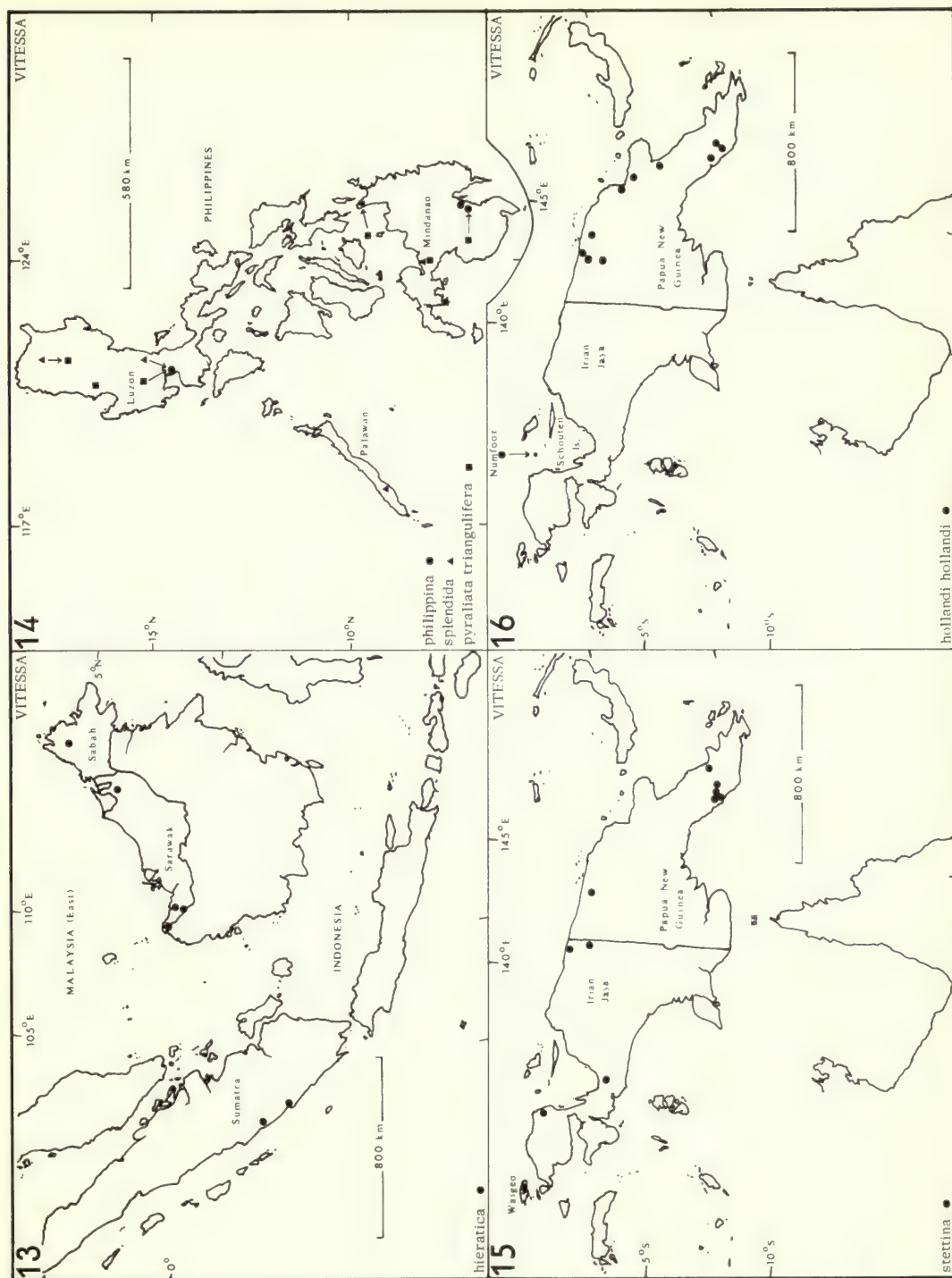
Figs 1-4 Distribution maps.



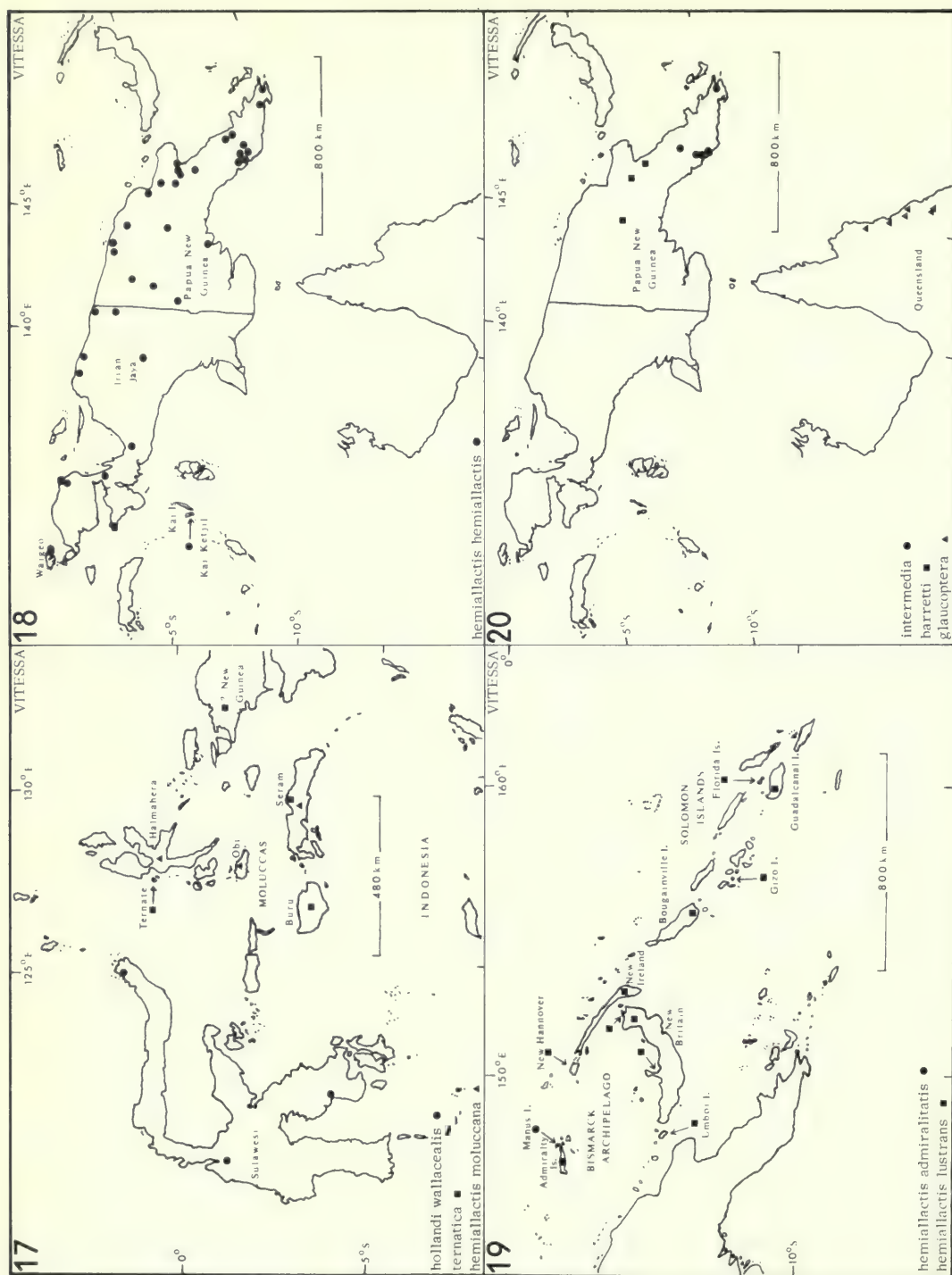
Figs 5-8 Distribution maps.



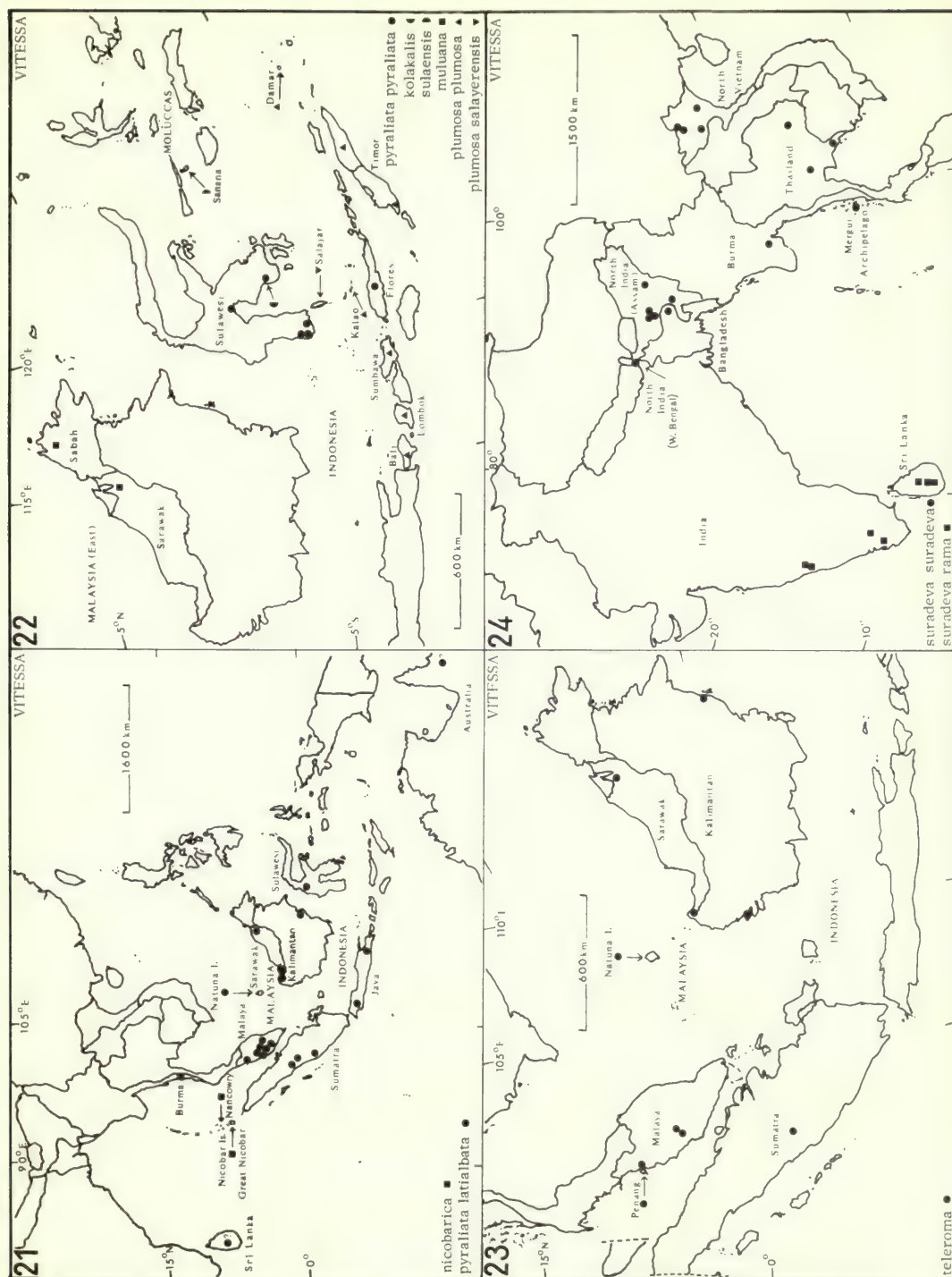
Figs 9-12 Distribution maps.



Figs 13-16 Distribution maps.



Figs 17-20 Distribution maps.



Figs 21-24 Distribution maps.

Head small. Frons rounded, shaggily or smoothly scaled, anteriorly directed plume of scales between antennae. Vertex short, scaling erect, woolly. Eye well developed, with long interfacetal hairs over central area. Ocellus large, conspicuous. Chaetosema elliptical, directed laterally, with long radiating setae. Antenna nearly as long as fore wing; thick, compressed, heavily ciliated in ♂; evenly short-pilose in ♀. Labial palpus in ♂ prominent, curved, upturned; first segment short, weakly curved; second segment thick, long, strongly curved, extending well above vertex, distally expanded, obliquely truncate; third segment acuminate, obliquely ascending from a subterminal origin on anterior surface of second segment. Labial palpus in ♀ shorter, obliquely ascending; first segment as in ♂; second segment slender, nearly straight, reaching about level of vertex; third segment straight, acuminate, continuing line of second. Maxillary palpus minute, directed medially toward base of proboscis. Proboscis long, strong, scaled at base. Neck region with slender erect scales. Body slender; abdomen long, exceeding hind wing. Legs long, slender; outer spurs shorter than inner; tarsi with long ventral spines. Fore wing in ♂ broad; costa nearly straight; apex rounded; termen curved, oblique; tornus angled; posterior margin nearly straight, narrowly curved at base. Wing in ♀ broader, costa convex, apex and termen more rounded. Costal area wide. Cell about half length of wing. Discocellular vein strongly angled at middle. *Sc* approaching or anastomosing with R_1 postmedially. R_1 from before apex of cell, approaching or anastomosing with R_2 . R_3 stalked with R_{4+5} . R_4 , R_5 long-stalked. M_1 stalked for a short distance with R_{3+5} . M_2 , M_3 stalked from posterior angle of cell. Cu_1 from just behind posterior angle. Cu_2 from cell at middle. *CuP* preserved near wing-base and termen. A_1 straight. A_2 forming a small loop and spur with A_1 . Hind wing broad; apex, termen, anal angle rounded. Costal area wide. Cell about half length of wing. Discocellular vein anteriorly straight, erect; at middle obtusely angled, with a distinct medial spur extending toward base; posterior part straight, oblique distad. *Sc* + R_1 anastomosed for most of postcellular length with Rs . M_1 basally apposed to or stalked with Rs . M_2 and M_3 stalked from posterior angle of cell. Cu_1 from behind posterior angle. Cu_2 from cell at middle. *CuP* and two anals present. Frenulum of ♀ with two long setae.

GENITALIA ♂ (Fig. 135). Uncus wide, deeply bifid, each process trumpet-shaped, with shaggy dorsal scales. Gnathos wide; lateral arms broad, dorsoventrally flattened, anteroventrally directed; medial element formed of paired claw-like, admedial, posterior processes, arising from a transverse band. Transtilla with broad triangular lateral elements, joined by a weak semimembranous medial section. Tegumen wide, arched; sclerotization narrowly stronger at origin of gnathos. Vinculum broad and rounded. Valve with broad rounded distal expansion; costa sigmoidal; a strengthening ridge, obsolescent distally; narrowly inflated and sclerotized, with small triangular expansion dorsally at tip. Juxta ovate, lightly sclerotized, with large V-shaped posteromedial emargination; on dorsal surface of anellus a posteriorly pointed V-shaped catena, with strong medial ridge. Aedeagus long, narrow and sinuate, basally rounded; junction of ductus ejaculatorius subbasal; manica without spines; vesica minutely spinose. Cornuti small, few and isolated, possibly deciduous.

GENITALIA ♀ (Figs 219–222). Ovipositor lobes low, cushion-like, dorsally rounded and separated. Setae short, longer on outer margin, all simple. Posterior apophysis short, with a symmetrical vertical bar. Anterior apophysis slightly longer, stronger, distally tapering, weakly bent near base. Eighth sternite triangular, deeply indented anteriorly, sides elongated and acuminate. Eighth tergite rectangular, ventrolaterally rounded, covered with setae. Ostial chamber small, unarmed. Ductus bursae long, slender, membranous; base with a pair of lateral sclerites extending to junction of ductus seminalis. Corpus bursae oval or comma-shaped, finely denticulate posteriorly, with weakly sclerotized signum.

REMARKS. This genus is known from two species, both from the central mountain ranges of New Guinea. We have no record of the habits, but the pattern suggests that the moths are diurnal. The genus differs from *Cosmethella* and *Vitessa* in a number of striking external and genital characters (see notes in Introduction), though there is a similarity in the structure of the labial palpi. In *Vitessidia*, however, they are longer in the ♂ than the ♀, whereas in *Cosmethella* they are longer in the ♀, and in *Vitessa* of the same length in both sexes. In the ♂ genitalia the anellus lacks lateral and medial spines, and is not reflexed after eversion; the ventral junction of the vesica to the aedeagus is plain, not rugose, hence the vesica is not reflexed after eversion. In this respect *Vitessidia* is similar to *Cosmethella*, but differs from *Vitessa*. In the ♀ genitalia the ovipositor lobes have simple setae, as in *Cosmethella*, unlike *Vitessa* where the ovipositor bears flattened spiny setae in addition to simple setae.

BIOLOGY. Early stages and host-plants unknown. Moths taken by various collectors from January to April and September to December.

DISTRIBUTION (Fig. 1). New Guinea: Irian Jaya; Papua New Guinea.

Key to the species of *Vitessidia*

- 1 Fore wing upperside with broad proximal and narrow curved preapical, translucent white areas; veins on white areas of upperside of fore and hind wings narrowly black . . . *diaphana* (p. 253)
- Fore wing upperside with irregularly ovoidal distal translucent white area; veins on white areas of fore and hind wings whitish buff, with little trace of infuscation . . . *geometrina* (p. 253)

***Vitessidia diaphana* Rothschild & Jordan, 1905**

(Figs 1, 45, 46, 135, 219, 221)

Vitessidia diaphana Rothschild & Jordan, 1905, *Novit. zool.* **12** : 475. Holotype ♂, NEW GUINEA: Papua, Angabunga R., afflu[ent] of St Joseph R., 1850 m ('6000 ft') upwards, xi.1904–ii.1905 (*Meek*) (genitalia slide no. 1503; BMNH) [examined].

Vitessidia diaphana Rothschild & Jordan; Janse, 1928 : 88.

♂, ♀. 47–56 mm. Frons shaggily scaled; in ♂ white, laterally bordered with black; in ♀ black, admixed and laterally bordered with white. Plume of scales between antennae white; in ♀ smaller, with less white. Vertex black. Eye black with pale interfacetal hairs. Ocellus buff, shiny. Chaetosema with pale yellowish setae. Antenna black. Labial palpus black; weak pale grey scaling on dorsal surfaces of second and third segments in ♂; pale grey scaling absent in ♀; ventral surfaces of first and second segments lightly admixed with white. Maxillary palpus buff-tinted. Basal scaling of proboscis black, minutely admixed with white at base in ♂, with more white in ♀. Neck region with black and orange scaling. Thorax above: blackish fuscous; patagium and tegula orange, scales black-tipped. Abdomen above: black, terminal segments orange. Body below and legs black; pectus, fore coxa, parts of mesal surfaces of all femora, and terminal abdominal segments orange. Fore wing above: ground colour, including fringe, black, with weak violaceous reflections. An irregularly quadrate, nacreous, translucent white area occupying much of proximal half of wing. A similarly coloured curved preapical area from cell at R_5 to cell at M_3 . Both areas intersected by narrow black vein-lines. Hind wing above: ground colour as on fore wing. A large ovate, nacreous, translucent white subbasal and discal area, intersected by black vein-lines, narrower than those of fore wing. Underside of fore and hind wings like upperside but less violaceous; retinaculum of fore wing glossy dark grey.

GENITALIA ♂ (Fig. 135). As described for genus.

GENITALIA ♀ (Figs 219, 221). In general as described for genus. Posterior apophysis slightly curved and tapering. Anterior apophysis evenly curved and weakly sinuate, tapering and finely acuminate. Ostial chamber weakly sclerotized, posterior opening wide, narrowing sharply anteriorly; proximal part of ductus bursae about six times as long as wide, paired sclerites long, narrow, strong. Corpus bursae oval; signum on posterior lobe near entrance to ductus bursae, a weakly sclerotized incurved plate, finely denticulated.

REMARKS. The wing markings, though similar to those of *V. geometrina*, are quite distinct. In the ♀ genitalia the apophyses are shorter and thicker; both the whole ductus bursae and its proximal parts and sclerites are longer. The corpus bursae is oval, not comma-shaped, and the signum is smaller and simpler.

BIOLOGY. Early stages and host-plant unknown. Moths collected in January to November.

DISTRIBUTION (Fig. 1). New Guinea: Irian Jaya; Papua New Guinea.

MATERIAL EXAMINED

New Guinea: 6 ♂, 8 ♀, Irian Jaya, Weyland Mts, Menoo Valley, Mt Kunupi, 1850 m, xi.1920–i. 1921 (*C., F. & J. Pratt*) (BMNH; TM, Pretoria). In addition, Dr Vári examined 19 ♂, 11 ♀ not seen by us (TM, Pretoria).

***Vitessidia geometrina* sp. n.**

(Figs 1, 47, 220, 222)

♂. Unknown.

♀. 44–48 mm. Frons smoothly scaled, black, laterally bordered with white. Plume of scales between antennae black with violaceous reflections; vertex of same colour, smoothly scaled; a small yellow tuft

behind antenna. Eye, ocellus, chaetosema as in *V. diaphana*. Antenna black, scape with slight admixture of white on inner surface. Labial palpus black, ventral surface of first and base of second segment admixed with white. Maxillary palpus buff-tinted. Basal scaling of proboscis black, admixed with white at extreme base. Neck region with black-based yellow scales. Body above, including patagium and tegula: black with violaceous reflections; border of anterior portion of terminal abdominal segment yellow. Thorax below and legs black; pectus, parts of fore and mid coxae yellow admixed with white; ventral surfaces of mid and hind femora white. Abdomen below: black, posterior margins of segments broadly white admixed with yellow, continuing narrowly on lateral surfaces to height of spiracles; terminal segment completely yellow. Fore wing: ground colour above, including fringe, black, with weak violaceous reflections. An irregularly ovoidal, nacreous, translucent white area on distal part of wing. Hind wing above: ground colour as on fore wing. A large, ovate, nacreous, translucent, white subbasal and discal area extending broadly to anal margin, showing whitish buff veins with slight infuscation; vein-lines of same thickness as in fore wing. Underside of fore and hind wings like upperside but less violaceous; on fore wing white admixture from base, spreading along anal margin and lightly up the termen; retinaculum glossy light grey; on hind wing white at base spreading along base of costa.

GENITALIA ♀ (Figs 220, 222). In general as described for genus. Posterior apophysis slightly curved and tapering. Anterior apophysis evenly curved and weakly sinuate, noticeably widened for first third of length, distally tapering, small central swelling at beginning of last third, tip blunt. Ostial chamber weakly sclerotized, posterior opening narrow, leading abruptly to ductus bursae. The latter shorter than in *V. diaphana*, its proximal part two to three times as long as wide, the paired sclerites relatively short. Corpus bursae distinctly comma-shaped; signum weak, elongate, nearly half as long as corpus, extending basad from junction of ductus bursae, forming deep, curved indentation along side of corpus, with evenly spaced, rib-like ripples at right-angles to margin along entire length. Opposite margin of corpus bursae finely denticulated.

REMARKS. The moths are smaller than in *V. diaphana* and have several distinctive external and genital characters. The ground colour of the fore and hind wings is lighter than *V. diaphana*. The white part of the fore wing is reduced to one patch. The white areas in this species are less nacreous.

BIOLOGY. Early stages and host-plant unknown. Moths collected in January to April, September to December.

DISTRIBUTION (Fig. 1). New Guinea: Irian Jaya; Papua New Guinea.

MATERIAL EXAMINED

Holotype ♀, **New Guinea:** Papua, Upp[er] Aroa R., i-iv. 1903 (*Meek*) (BMNH).

Paratypes. **New Guinea:** 2 ♀, Irian Jaya, Snow Mts, nr Oetakwa R., up to 1050 m ('3500 ft'), x-xii.1910 (*Meek*) (genitalia slide no.'s 1504, 15282; BMNH); 1 ♀, I. J., Snow Mts, Upper Setekwa R., 600-900 m ('2000-3000 ft'), ix.1910 (*Meek*) (genitalia slide no. 14675; BMNH); 1 ♀, I. J., Araucaria Camp, 800 m, iii. 1939 (*Toxopeus*) (RNH, Leiden).

COSMETHELLA gen. n.

Gender: feminine

Type-species: *Vitessa unipetinalis* Hampson.

Head small. Frons rounded, narrow, smoothly scaled. Vertex flat, somewhat elevated, with rough, forward-directed scales. Eye large. Ocellus absent. Chaetosema elliptical, close to eye, directed posterolaterally, bearing long radiating setae. Antenna about two-thirds length of wing, compressed, distinctly unipetinate in both sexes. Labial palpus in ♂ shorter than in ♀; slender, obliquely upturned; first segment short; second segment long, in ♂ reaching level of vertex, in ♀ well above vertex, third segment equal in length to second in ♂, shorter than second in ♀, acuminate and usually continuing line of second segment. Maxillary palpus short, directed medially, with distal, weakly dilated, triangular tuft of scales. Proboscis weak but coiled, scaled at base. Body slender; abdomen long, exceeding hind wings. Legs short, robust, with long strong tibial spurs, outer spurs shorter than inner; tarsi ventrally spined. Fore wing narrow; costa nearly straight, strongly curved near base; apex narrowly rounded; termen slightly curved and oblique; tornus obtuse; posterior margin slightly curved, more strongly at base. Costal area wide. Cell about half length of wing. Discocellular vein concave distad. *Sc* well separated from *R* and *R*₁. *R*₁ from

cell at two-thirds from base. R_{2+5} from apex of cell; R_2 stalked with R_{3+5} ; R_5 stalked for a variable distance with R_{3+4} . M_1 from anterior angle of cell, or stalked for a very short distance with R_{2+5} ; except for this stalking its base not apposed to that of R_{2+5} . M_2 and M_3 short-stalked from posterior angle of cell. Cu_1 from just behind posterior angle. Cu_2 from cell at four-fifths from base. CuP preserved near wing base and termen. A_1 straight. A_2 forming a small loop and spur. Hind wing narrow; apex, termen and anal angle rounded. Costal area wide. Cell about half length of wing. Discocellular vein with strong basally directed angulation before middle, posterior part distally oblique. $Sc+R_1$ not anastomosed with Rs . M_1 stalked with Rs for short distance beyond cell. M_2 and M_3 stalked from posterior angle of cell. Cu_1 from behind posterior angle. Cu_2 from cell at three-fourths from base. CuP , A_1 and A_2 present. Frenulum of ♀ with two long setae.

GENITALIA ♂ (Fig. 136). Uncus narrow, parallel-sided, constricted at base, rounded at tip; tip and postero-lateral margin with fine setae dorsally. Gnathos with curved lateral arms, meeting at mid-line in an acute angle, forming strong medial spur. Transtilla strong, complete, with dorsal arch in mid-line. Tegumen short, wide, angular, with strong shoulders. Vinculum broad, thickened ventrally, dorsally with a curved, medially directed process on each side, supporting a membranous setose area. Valve short, wide, fan-shaped; costa nearly straight, with narrow tubular thickening; terminal margin long, curved; sacculus weakly thickened, not strongly sclerotized, generally recurved, ending in a produced posteroventral angle; mesal surface densely covered with setae arranged on radiating striations. Juxta large, deeply bifurcate dorsally; each side with a long slender process, in slide preparations reaching half length of uncus; also a short, sharp, laterally directed process on each side near the curved ventral edge; anellus simple. Aedeagus short, narrow, slightly sinuate, basally rounded; ductus ejaculatorius arising mid-way; posterior end minutely spinose; vesica large, membranous, sac-like, lacking spines but with small, thin sclerotized bands at either end; cornuti absent.

GENITALIA ♀ (Figs 223–225, 269–271, 315). Ovipositor lobes small, narrow, dorsally rounded and connected. Setae short, longer on outer margin, all simple (Fig. 315). Posterior apophysis long and slender, vertical bar incomplete. Anterior apophysis as long as but thicker than posterior, slightly sinuate. Eighth sternite triangular. Eighth tergite rectangular, several transverse rows of setae on posterior portion. Ostial chamber wide, with long, wide, simple, scobinated antrum in dorsal wall, extending anteriorly into a short caecum of ostial chamber. Ductus bursae short and wide. Corpus bursae large, cylindrical, more or less J-shaped; signum absent.

REMARKS. This genus is known from three species, two represented only by holotypes. Though the holotype of *C. minor* was taken at light, the apparently mimetic pattern suggests that the moths are probably mainly diurnal. The genus differs from *Vitessidia* in both external and genital characters; as explained in the Introduction, the two genera are probably not closely related. The eye, unlike that of *Vitessidia*, lacks interfacetal hairs. The antenna of *Cosmethella* is unipectinate, not simple as in *Vitessidia*. The labial palpus is longer in the ♀ than in the ♂ in *Cosmethella*, the opposite in *Vitessidia*. The two genera share the relatively plain anellus, lacking spines and not reflexed after eversion. In both genera the vesica lacks the reflexing mechanism found in *Vitessa*.

Cosmethella is closely related to *Vitessa* but differs in a number of characters. The antenna is unipectinate in both sexes in *Cosmethella*, not bipectinate in the ♂ and laminate in the ♀. The labial palpus is longer in the ♂ of *Cosmethella* and much longer in the ♀, not shorter and of equal length in the sexes as in *Vitessa*; in *Cosmethella* it has the second segment straight and oblique, not curved basally. *Cosmethella* shares with *Vitessa* the prominent maxillary palpus. The cell is shorter in both fore and hind wings. R_2 of the fore wing is stalked with R_{3+5} , whereas in *Vitessa* it arises from the cell. Like *Vitessa*, this genus has $Sc+R_1$ anastomosed with Rs . The genitalia in both sexes differ very markedly from those of *Vitessa*, particularly in shape of valve in the ♂. In the ♀ the ovipositor lobes have simple setae; in all examined species of *Vitessa* some setae are covered with spines. There are also distinct differences in the shape of the antrum, ductus bursae and corpus bursae.

BIOLOGY. Early stages and host-plants unknown. Moths so far taken by only a few collectors from January to March and from October to December.

DISTRIBUTION (Figs 2, 3). New Guinea: Papua New Guinea. Solomon Islands.

Key to the species of *Cosmethella*

- 1 Thorax purplish fuscous; fore wing with pale antemedial fascia about one-sixth as wide as long.
Solomon Islands *unipectinalis* (p. 256)
- Thorax orange-yellow with black spots; fore wing with pale antemedial fascia more than one-third as wide as long. New Guinea 2
- 2 Longest antennal pectinations in ♀ about three times as long as width of antennal shaft; fore wing with antemedial fascia narrowed behind, forming a semicircular patch; expanse under 30 mm *minor* (p. 256)
- Longest antennal pectinations in ♀ about six times as long as width of antennal shaft; fore wing with antemedial fascia scarcely narrowed behind, meeting posterior margin broadly; expanse over 40 mm *major* (p. 257)

***Cosmethella unipectinalis* (Hampson, 1906) comb. n.**

(Figs 2, 48, 49, 136, 223, 269)

Vitessa unipectinalis Hampson, 1906, *Ann. Mag. nat. Hist.* (7) 17: 217. LECTOTYPE ♂, SOLOMON ISLANDS: Gizo I. (Meek) (genitalia slide no. 15283; BMNH), here designated [examined].

♂, ♀. 32–38 mm. Frons, vertex orange, with darker shading laterally. Eye black. Chaetosema with setae yellow. Antenna fuscous. Labial palpus fuscous, ventral surface of second segment in ♂ light brown, tip of palpus light brown in both sexes. Maxillary palpus fuscous. Basal scaling of proboscis blue-black. Neck region orange. Thorax above: patagium, tegula and abdomen above metallic blue-black; in ♂ a slight admixture of orange in most abdominal segments; terminal segment orange. Underside of thorax and abdomen like upperside, terminal segment admixed with black. Legs metallic blue-black. Fore wing: ground colour above metallic blue-black. A narrow, oblique, white antemedial fascia, slightly curved at costal end. A white longitudinal stripe in cell R_5 , a smaller white stripe above. A narrow triangular white apical patch. Fringe fuscous. Hind wing above metallic purplish fuscous, unmarked. Underside of wings purplish fuscous. On fore wing faint traces of proximal line and stripe in cell R_5 ; apical patch distinct.

GENITALIA ♂ (Fig. 136). As described for genus.

GENITALIA ♀ (Figs 223, 269). In general as described for genus. Apophyses nearly straight. Eighth tergite with irregularly distributed setae. Eighth sternite indented at posterior angle. Caecum slightly wider than antrum. Sides of antrum slightly curved, broadly rounded posteriorly.

REMARKS. This geographically isolated species can be distinguished by its narrow proximal fascia and smaller, distinct apical marking, also by its blue-black thorax.

BIOLOGY. Early stages and host-plant unknown. Moths collected from January to March and in November and December.

DISTRIBUTION (Fig. 2). Solomon Islands.

MATERIAL EXAMINED

Paralectotype. 1 ♂, data as lectotype (abdomen missing; BMNH).

Solomon Islands: 4 ♂, north side of Choiseul I., xii.1903 (Meek) (BMNH); 3 ♂, south side of Choiseul I., i.1904 (Meek) (BMNH); 1 ♂, 1 ♀, Vella Lavella I., ii. and iii. 1908 (Meek) (BMNH); 9 ♂, 4 ♀, Gizo I., 1903 and xi.1903 (Meek) (BMNH; NMNH, Washington).

***Cosmethella minor* sp. n.**

(Figs 3, 50, 224, 270, 315)

♂. Unknown.

♀. 28 mm. Frons, vertex orange. Eye fuscous. Chaetosema setae yellow. Antenna black. Labial palpus black, some orange scaling basally and distally. Maxillary palpus basally black, distally orange. Basal scaling of proboscis black. Neck region orange. Thorax above: tegula orange, with an anterior black spot. Abdomen above: metallic blue-black, terminal segment orange. Thorax and abdomen below: blue-black, terminal segment orange. Legs blue-black, grey-banded. Fore wing above: ground colour black with purplish reflections. A small orange basal spot on *Cu*. A narrow, erect, diffuse, white subbasal fascia. A large, white, nearly semicircular antemedial fascia, not reaching costa or posterior margin. Discocellular vein and longitudinal veins in terminal half of wing outlined in whitish grey. A creamy apical patch

diffusing into the vein-lines. Fringe fuscous. Hind wing and fringe with purple reflections, unmarked. Fore wing below: fuscous, shading to pale grey on posterior margin. A large, posteriorly narrowing, white subterminal fascia, narrowly outlined with black anteriorly and distally. Underside of hind wing similar to upperside.

GENITALIA ♀ (Figs 224, 270, 315). In general as described for genus. Posterior apophysis slender and nearly straight. Anterior apophysis curved. Eighth sternite a nearly equilateral triangle. Caecum short and weak.

REMARKS. This species is distinct from *C. unipeptinalis* in fore wing markings and colour of thorax (see key). The ♀ genitalia differ from those of *C. unipeptinalis* in the long ovipositor lobes, curved posterior apophysis, more anteriorly concentrated setae of eighth tergite, shorter caecum, and broader antrum, with posterior end angled medially rather than round. *C. minor* resembles *C. major* in general appearance, but differs in the shorter antennal pectinations and in the markings of the fore wing, as follows: the proximal fascia of the upperside is posteriorly constricted in the present species and the pale apical patch of the upperside is narrow; on the underside the subterminal pale fascia is posteriorly elongate. The eighth sternite forms a nearly equilateral triangle rather than a wider, truncated one as in *C. major*. The fore wing markings bear a slight resemblance to those of *Vitessa cyanea*, enhanced by the uniformly dark hind wing; in all other aspects the two species are quite distinct.

BIOLOGY. Early stages and host-plant unknown. Holotype collected in October at mercury-vapour light.

DISTRIBUTION (Fig. 3). New Guinea: Papua New Guinea.

MATERIAL EXAMINED

Holotype ♀, **New Guinea**: North-east New Guinea, Wewak, Dagua Road, near sea level, 21.x.1957, at mercury-vapour light (*Munroe & Holland*) (genitalia slide no. DK 107; CNC, Ottawa; type no. 11,012).

Cosmethella major sp. n.

(Figs 3, 51, 225, 271)

♂. Unknown.

♀. 42 mm. Frons orange. Vertex orange, posteriorly yellow. Eye fuscous. Chaetosema setae yellow. Antenna fuscous. Labial palpus fuscous; orange scaling on ventral surface of second segment; tip of palpus light brown. Maxillary palpus fuscous, orange-tipped. Basal scaling of proboscis black. Neck region orange. Thorax above: patagium and tegula orange, each with a black anterior spot. Abdomen black above, terminal segment orange. Thorax, abdomen below: black; a thin band of orange on pectus; terminal segment orange. Legs black, grey-banded. Fore wing above: ground colour black with faint purplish lustre; a small orange basal spot on *Cu*; a narrow, arcuate, creamy white subbasal fascia. Antemedial fascia broad, weakly oblique medially, creamy white; commencing narrowly behind costa, rapidly widening and extending broadly to posterior margin. A creamy spot on discocellular vein near posterior angle of cell. Longitudinal veins in terminal half of wing outlined in creamy yellow. A fairly wide, triangular, creamy yellow subapical patch, bordered by a narrow black marginal line. Fringe fuscous. Hind wing and fringe black with purple reflections, unmarked. Fore wing below: fuscous with purple reflections; subapical patch as on upperside; a diffuse, pale proximal area and pale posterior margin. Hind wing below as on upperside.

GENITALIA ♀ (Figs 225, 271). In general as described for genus. Posterior apophysis weakly sinuate. Anterior apophysis angled near base. Eighth tergite with one irregular, major, transverse, posterior row of setae, numerous setae scattered over remaining area. Eighth sternite subtriangular, wider than long, posteriorly truncated. Sclerotized antrum with narrow diverticulum and long subacute process.

REMARKS. This species resembles *C. minor*; differential characters are noted under that species. The development of the antrum is the most distinctive genital character.

BIOLOGY. Early stages and host-plant unknown. Holotype collected in March.

DISTRIBUTION (Fig. 3). New Guinea: Papua New Guinea.

MATERIAL EXAMINED

Holotype ♀, **New Guinea**: Mambare R., Biagi, 1500 m ('5000 ft'), iii.1906 (*Meek*) (genitalia slide no. 14698, BMNH).

VITESSA Moore, [1860]

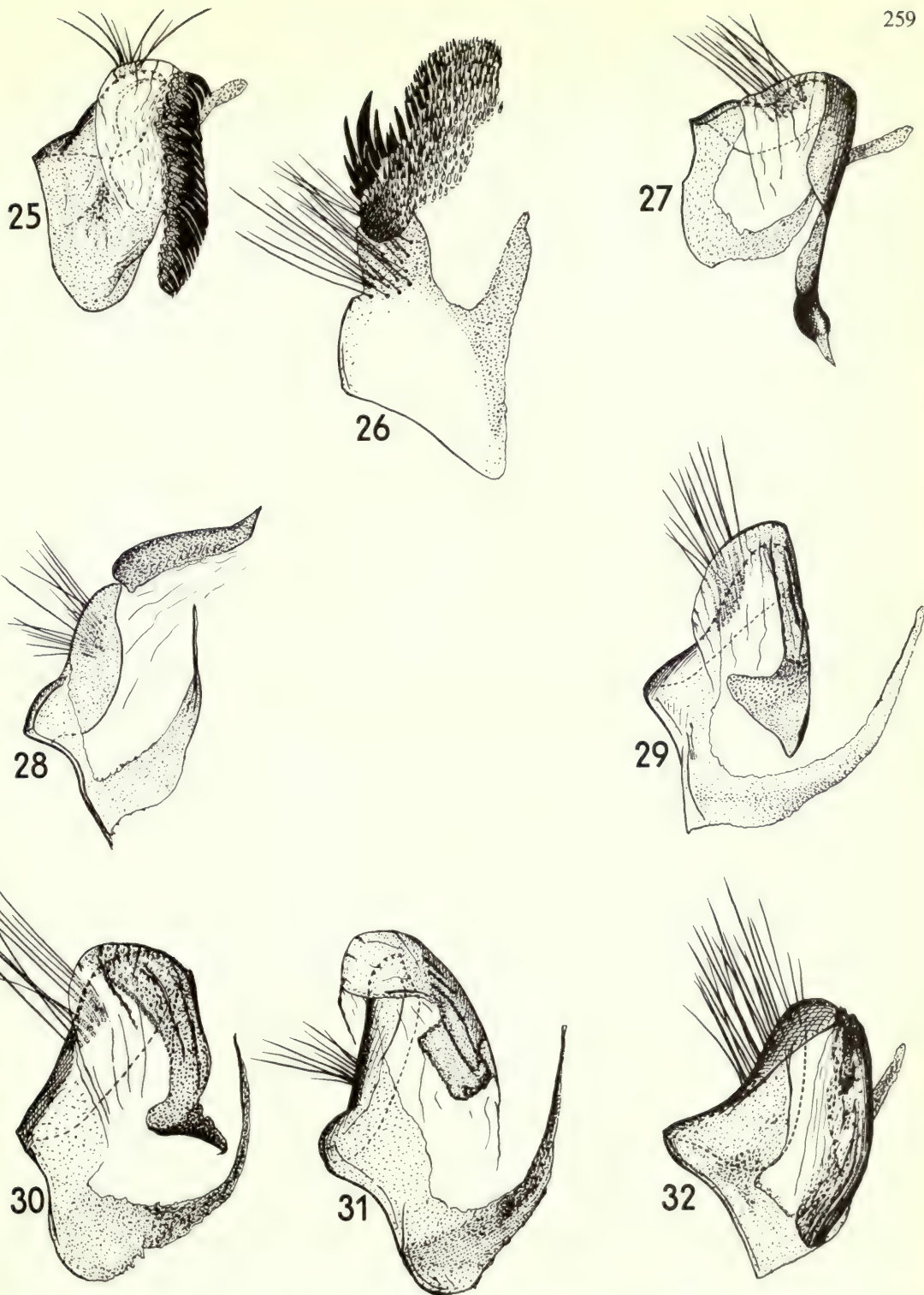
Vitessa Moore, [1860,] in Horsfield & Moore, *Cat. lepid. Insects Mus. nat. Hist. East-India House* 2 : 299.

Type-species: *Vitessa suradeva* Moore, [1860], by original designation and monotypy.

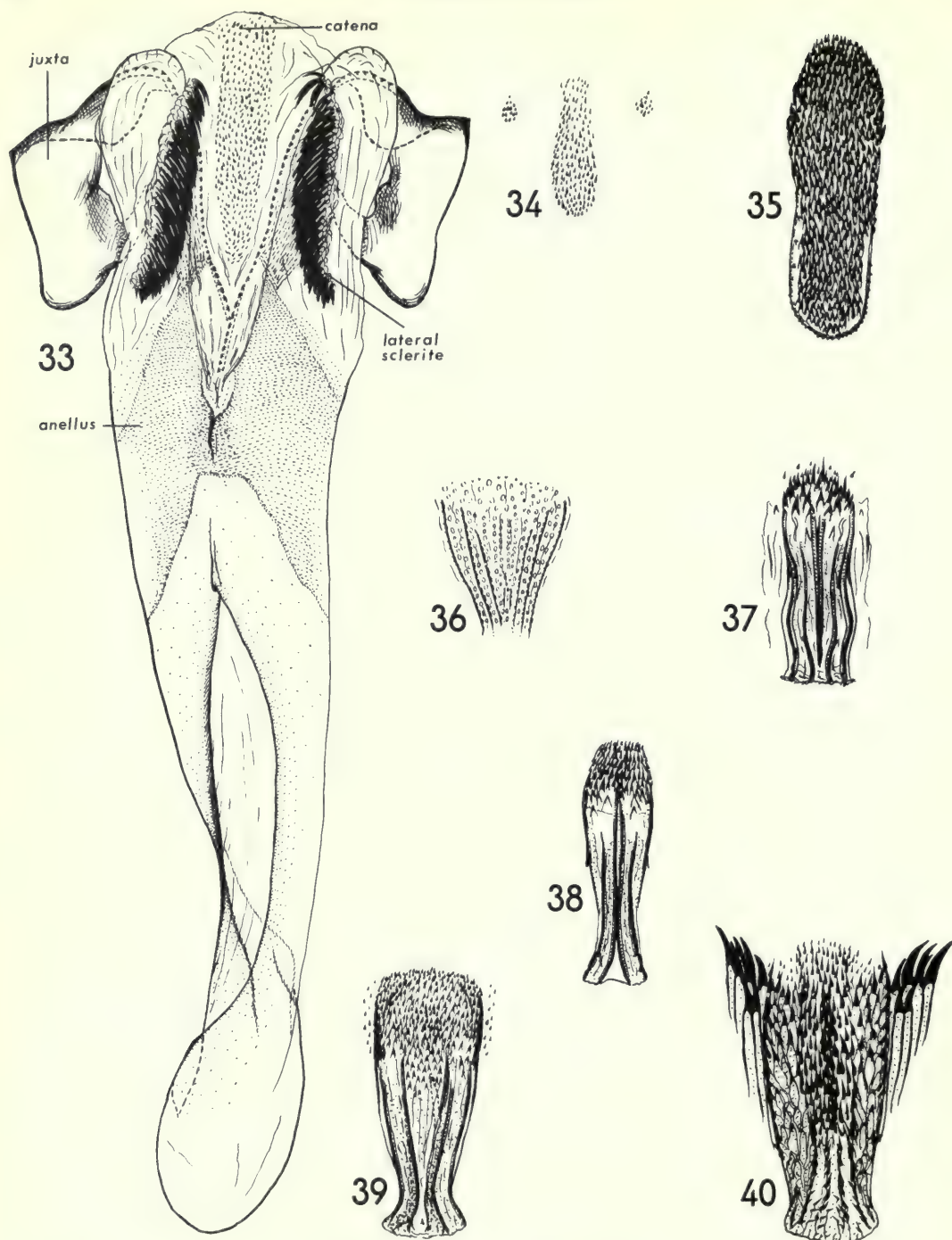
[*Cosmethis* Hübner; sensu de Joannis, 1930 : 637. Erroneous type-species designation.]

Head large. Frons rounded, narrow, its scaling rough or smooth. Vertex short, with erect, compact, woolly scaling. Eye large. Ocellus usually present, inconspicuous, sometimes weak or absent. Chaetosema elliptical, adjacent to eye, directed laterally, with long radiating setae. Antenna variable in length, more than half, less than three-quarters length of fore wing; bipectinate in ♂, compressed, laminate in ♀, postaxial pectinations in ♂ usually considerably longer than preaxial ones; pectinations flat, spatulate, capable of folding like slats of a Venetian blind. Labial palpus long, more or less equal in the sexes, obliquely or fully upturned, exceeding level of vertex; first segment very short; second segment long, cylindrical, slightly curved, not reaching level of vertex; third segment more slender, cylindrical, acuminate, varying from two-thirds to fully as long as second segment. Maxillary palpus short, distally somewhat dilated with scales, mesally directed. Proboscis long, strong, basally widened and scaled. Body robust, abdomen exceeding hind wing. Legs fairly long, robust; spurs long, outer somewhat shorter than inner; tarsi ventrally spined. Fore wing long, narrow, usually two and a half to three times as long as wide; in ♀ a little wider and with apex more rounded than in ♂; costa straight, gently arched or weakly sinuate; apex rounded; termen generally weakly rounded and a little oblique; tornus oblique or rounded; posterior margin nearly straight, but convex near base. Costal area wide. Cell more than half length of wing. Anterior discocellular vein short, at a distinct angle to middle discocellular. *Sc* separated from radial stem and *R*₁. *R*₁ arising from cell. *R*₂ from before end of cell. *R*₃₊₄ stalked with *R*₅ for a short distance; *R*₃ and *R*₄ with a short stalk beyond separation of *R*₅. *M*₁ arising at junction of anterior and middle discocellular veins, obliquely divergent from *R*₅ at base. *M*₂ and *M*₃ short-stalked from posterior angle of cell. *Cu*₁ from a little behind posterior angle. *Cu*₂ variable in position, always from well out on cell. Anal fold strong. Terminal part of *CuP* developed or absent. *A*₁ long and strong, connected with *A*₂ by an outwardly oblique cross-vein, or *A*₂ looped to *A*₁. Hind wing long and narrow; apex narrowly rounded, termen broadly rounded, anal angle rounded. Costal area wide. Cell about half length of wing. Discocellular vein strongly angled or incurved at middle; anterior and posterior angles of cell acute, posterior angle projecting further distad than anterior angle. *Sc* + *R*₁ long and straight, reaching apex of wing. *Rs* weaker than *Sc* + *R*₁, paralleling it closely to beyond middle of wing, but not anastomosing with it, diverging distally. *M*₁ stalked with *Rs*. *M*₂ and *M*₃ from posterior angle of cell, basally approximated or short-stalked. *Cu*₁ from cell somewhat behind posterior angle; *Cu*₂ from cell at two-thirds from base. *CuP*, *A*₁ and *A*₂ present. Frenulum of ♀ with two long setae.

GENITALIA ♂ (Figs 25–41, 43, 44, 137–218). Uncus slender: in *griseata*- and *hieratica*-groups shorter and pyriform, bearing anteriorly directed setae on each side; in other groups with distal part slender, rod-shaped, with sparse, laterally directed setae on each side. Gnathos wide, with broad, flat, posteriorly curved arms, acutely angled mesally, joined to form a long, strong, tapering and acuminate process, broadly curved dorsad at some point in its length. Transtilla strong, of even width, V-shaped or arcuate, often with a more heavily sclerotized dorsal bar. Tegumen wide, with pronounced shoulders; its anterior margin with a narrow, V-shaped, medially deeply emarginated sclerite and its posterior margin with a broad semicircular or subtriangular sclerite. Vinculum narrow, ventrally flattened, with a pair of small accessory sclerites. Valve variable in form; costa strengthened; mesal surface strongly setose; usually with a low ridge-like clasper of varying form, absent in most of *zemire*-group. Juxta well developed, divided into a pair of lateral sclerites, each with dorsal and ventral processes directed medially, dorsal process articulating with lateral sclerite of anellus; this sclerite of varying form, generally linguiform and spinose, directed anteromedially when retracted (Figs 25–32). Dorsal medial catena spines on anellus large, small or absent (Figs 33–40). Manica long, tapering; medially directed sclerotized bands supporting part of length. Lateral sclerite of anellus hinging on articulation with juxta, capable of reflexion or extension as aedeagus is retracted or protruded (Fig. 33). Extension or reflexion of lateral sclerite independent of eversion or inversion of anellus in dissected genitalia with aedeagus removed. Aedeagus long, narrow, tubular, expanded distally, narrowly rounded basally; ductus ejaculatorius arising subbasally; aedeagus rugose at ventral connection to vesica, usually heavily spinose; rugose area longitudinal or transverse, apposed on dorsal connection by longitudinal rugose tissue or longitudinal bands of sclerotization. Junction of aedeagus with vesica at rugose area capable of reflexion, both before and after eversion (Fig. 41). Vesica long and tubular, with variable area and number of minute spines dorsally and ventrally at base. Cornuti present, deciduous to some extent, grouped in clusters or long bands of varying size, in various combinations: two larger dorsolateral clusters and one smaller ventromedial cluster, or, two large dorsolateral clusters, sometimes with one either smaller or absent.



Figs 25–32 ♂ genitalia. Details of left juxta sclerite and its connection with lateral sclerite of anellus in representative species of *Vitessa* to show variation within the genus. (25) *V. griseata* Kenrick. (26) *V. zemire nephritica* subsp. n. (27) *V. hieratica* Swinhoe. (28) *V. stettina* Swinhoe. (29) *V. hemiallactis hemiallactis* Meyrick. (30) *V. pyraliata latialbata* subsp. n. (31) *V. plumosa plumosa* Hampson. (32) *V. suradeva rama* Moore.



Figs 33–40 ♂ genitalia. Details of dorsal catena of anellus in representative species of *Vitessa* to show variation within the genus. Fig. 33 also shows the juxta, lateral sclerites and everted, reflexed anellus to illustrate the position of the catena in relation to these parts. (33) *V. griseata* Kenrick. (34) *V. cyanea cyanea* Hampson. (35) *V. hieratica* Swinhoe. (36) *V. stettina* Swinhoe. (37) *V. hemiallactis admiralitatis* subsp. n. (38) *V. pyraliata latialbata* subsp. n. (39) *V. plumosa plumosa* Hampson. (40) *V. suradeva suradeva* Moore.

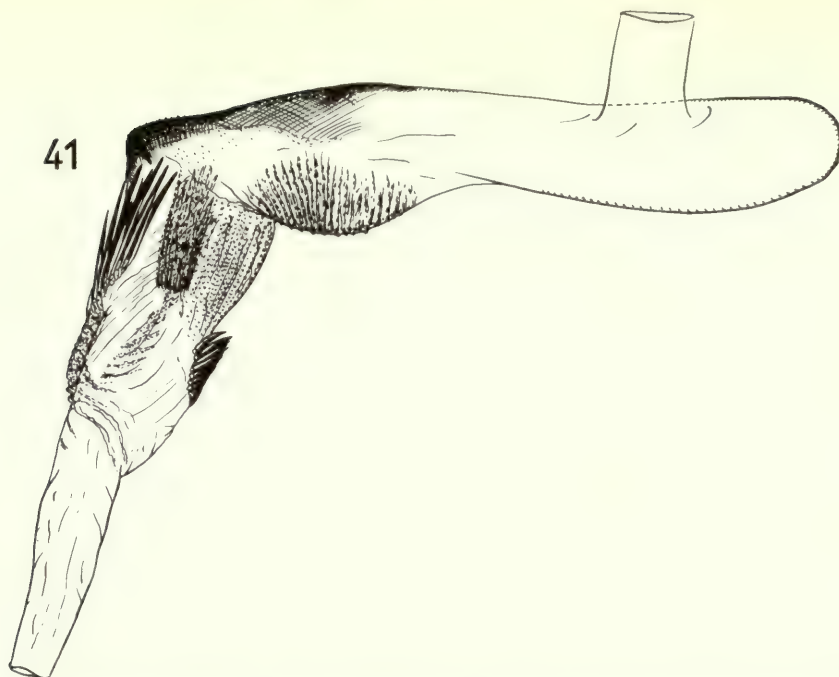


Fig. 41 ♂ genitalia. Lateral view of aedeagus illustrating everted vesica in reflexed position.
Vitessa pyraliata pyraliata Walker.

GENITALIA ♀ (Figs 226–268, 272–314, 316–318). Ovipositor lobes long, fairly wide, dorsally fused and produced posteriad; posterior surface setose, margins with a moderately thick fringe of longer setae; longer setae and some of the smaller, round, tubular and simple, a varying number of smaller setae flattened and bearing spines for most of their length. Posterior apophysis curved, of moderate thickness, mostly blunt-tipped. Anterior apophysis longer, thicker, weakly sinuate, mostly blunt-tipped. Eighth tergite broad, indented posteromedially, bluntly protruded anteromedially; densely setose posteriorly and laterally. Ostium wide. Posterior ostial sclerite with posterior margin curved; anterior margin with lateral prolongations of varying length and shape, sometimes expanded toward mid-line to form large bullae. Anterior ostial sclerite with posterior margin recurved, wrinkled. Antrum wide, variably extended anteriorly, posterior part sometimes weak. Ostial end of ductus bursae mostly funnel-shaped, wrinkled, with weak lateral sclerotizations; continuing as a slender membranous tube to corpus bursae. Corpus bursae globular or oval, membranous; with two depressed, finely denticulate signa, with paired denticulate areas, or without signa.

REMARKS. We recognize eight species-groups. In the *griseata*-group the valve has a small, central, almost vestigial clasper; the uncus is pyriform-subtriangular, as in *Cosmethella*; the hind wing, as in *Cosmethella*, is black. In the *hieratica*-group the uncus is similar in shape but the valve is armed on the posterior margin with a small, pointed clasper; the discal area of the hind wing is white. In the remaining six groups the uncus has a wide basal portion and a rod-like distal portion, the latter decurved, fitting closely into the curve of the gnathos and bearing sparse lateral setae. In the *suradeva*-group the costa of the valve is curved at the base, enabling the valve to open horizontally rather than obliquely; in the remaining groups the costa of the valve is straight basally, as in the *griseata*-group. The *zemire*-group has black hind wings and a fluted valve, mostly with no clasper; the condition of the uncus is transitional from that in the *griseata*- and *hieratica*-groups to that of the remaining five groups (including the *suradeva*-group, above), the basal portion being less sharply differentiated from the rod-like distal portion than in the latter series of groups. The *stettina*-group has a weak clasper on posterior margin of the narrow valve and in the ♀ the antrum is weakly sclerotized. In the *hemiallactis*-group the valve is wide

and basally constricted, the clasper is long, serrate and well developed and in the ♀ the ostial sclerotization is strong. In the *plumosa*-group the clasper of the valve has a strong, truncate and bifid-tipped ventral process, the ostial chamber has a complex folded sclerite on each side. In the *pyraliata*-group the clasper of the valve is coarsely serrate and the margins of the ostial chamber are wide and heavily sclerotized. Within the species-groups, spined setae on the ovipositor lobes are most easily seen in the *pyraliata*-group and least easily seen in the *griseata*- and *zemire*-groups. To be distinguished easily the spined setae require study under a compound microscope; the examples shown in Figs 316–318 were photographed at about $\times 250$ magnification by the use of differentiated interference-contrast microscopy.

BIOLOGY. Available information on the life-history is given in detail below, under *Vitessa suradeva rama*. The larvae of the species are gregarious web-makers on the undersides of leaves of *Chailletia sumatrana* Miquel (= *Dichapetalum gelanioides* subsp. *gelanioides* (Beddome) Engler) (Dichapetalaceae). They are gregarious when young, solitary later, commonly sitting in a 'semilooper' position. They are long, oily-black, marked with white, with orange head, anal segment and prolegs. Their bright colours may be aposematic. The pupa is formed in a cocoon just under the ground against sides of stones or in a similar protected place. *V. suradeva* ordinarily flies in the daytime and visits flowers in company with hypsids. Specimens of *V. hemiallactis hemiallactis* from Waigeo, Camp Nok, collected by Cheesman, are labelled as being diurnal. However, the adults of at least some of the species, including *V. suradeva*, *griseata*, *zemire*, *hollandi* and *hemiallactis*, are active nocturnally, though the bright colours might seem better adapted to diurnal life. The general aspect is that of aposematic or mimetic insects (see Introduction, p. 242). This is supported by the presence of noctuoids of closely similar appearance in the same areas, and by the similar patterns and parallel geographical variation of the forewings in species of different groups, e.g. the greenish *V. griseata* and *V. barretti* in the highlands of New Guinea, the black and white *V. zemire*, *V. stettina* and *V. hemiallactis* at lower altitudes in New Guinea, the greenish *V. glaucoptera* and *V. zemire nephritica* in Queensland, and the dark, white-spotted *V. pyraliata triangulifera* and *V. philippina* in Luzon.

DISTRIBUTION. Northern India and Sri Lanka to Queensland and Samoa.

BIOGEOGRAPHY (Figs 2–24). The *griseata*-, *zemire*-, *stettina*- and *hemiallactis*-groups are mainly Papuan; all extend west into the Moluccas and the *stettina*-group reaches the Philippines. The *hemiallactis*- and *zemire*-groups extend south to Queensland and south-east into the Solomon Islands. The *zemire*-group ranges farther, to the New Hebrides, Fiji and Samoa. The *hieratica*-, *plumosa*-, and *pyraliata*-groups are centred on the Malayan subregion; the *hieratica*-group ranges from Sumatra to Borneo, the *plumosa*-group through the Lesser Sunda Islands and north to Salajar, and the *pyraliata*-group from the Nicobar Islands and possibly Sri Lanka to the Philippines, Flores and possibly northern Australia. The *suradeva*-group is Indo-Malayan, ranging from Sri Lanka and the Himalayas to Borneo.

Turning to distributions within the groups, the *griseata*-group has four known species. *V. griseata* is widely distributed in New Guinea at altitudes from about 450 to 1850 m. This species is replaced by the closely related *V. brandti* in the mountains of New Britain. The remaining two species of the group, *V. talboti* and *V. nobilis*, occur in Seram and Ambon respectively; the former at least appears to be a mountain species.

The *zemire*-group consists of four species. The polytypic *V. zemire* extends from the Moluccas to the New Hebrides. *V. vitalis* in Fiji and *V. tamsi* in Samoa form a closely related pair. *V. cyanea*, the fourth species of the group, overlaps *V. zemire* in eastern New Guinea and adjacent coastal islands and has a widely disjunct subspecies in the Moluccas. The subspecies of *V. zemire* form regional groupings. In the New Guinea subspecies the postmedial fascia of the fore wing is very wide; in the Queensland subspecies the fascia is strongly green-tinted; it is equally wide, but tends to diffuse across the medial region to meet similar diffusion from the antemedial fascia. The two Moluccan and one New Hebrides subspecies have somewhat narrower postmedial fasciae; the remaining two subspecies from the Bismarck and Solomon Islands have much narrower postmedial fasciae.

The single known species of the *hieratica*-group is rare in collections. So far it is known from Borneo and Sumatra.

The three species of the *stettina*-group are largely allopatric. *V. stettina*, a species with wide pale fasciae on the fore wing, ranges from Waigeo and the Arfak Mountains to eastern Papua. It is the dominant species in southern New Guinea, but its range is widely overlapped by that of *V. hollandi*, a species with restricted pale fasciae. *V. hollandi* occurs in the Schouten Islands sympatrically with the externally almost indistinguishable *V. gemina* of the *pyraliata*-group. A distinct subspecies of *V. hollandi* occurs in Sulawesi; two specimens are known from the islands in the Moluccan group and a single specimen from New Britain; though these probably represent distinct subspecies we do not name them here. In the Philippines the *stettina*-group is represented by a distinct species, *V. philippina*, which is dark, with reduced light spots; externally this species closely resembles the sympatric *V. pyraliata triangulifera*, of the *pyraliata*-group.

The *hemiallactis*-group has six species. Of these the polytypic *V. hemiallactis* is the most widely distributed, with one subspecies in Halmahera and Obi in the Moluccas, a second in New Guinea, a third in the Admiralty Islands, a fourth in the Bismarcks and a fifth in the Solomon Islands. The fore wing patterns parallel those of sympatric members of the *stettina*-group. The New Guinea subspecies has moderately narrow, at most weakly interrupted, white fasciae, almost identical with those of *V. hollandi hollandi*, whereas in the remaining subspecies the fasciae are very much reduced, being both narrower and more widely interrupted. Overlapping *V. hemiallactis hemiallactis* in geographical range, though mostly occurring at somewhat higher altitudes, is the slightly larger second species, *V. intermedia*. The wide greenish white fasciae of this species parallel the markings of *V. stettina*, which occurs both with *V. intermedia* and at lower altitudes. In Queensland the geographically representative species *V. glaucoptera* has the fore wing green-suffused, like that of *V. zemire nephritica* from the same area. At altitudes of 600 to about 1850 m and possibly higher in New Guinea there occurs another representative species with strongly greenish fore wings, namely *V. barretti*; this species superficially resembles the more abundant *V. griseata*, which occurs together with it. A fifth species, *V. ternatica*, is known from the Moluccas from Ternate to Buru and Seram. A sixth, *V. cristobalensis*, is known only from San Cristobal in the Solomon Islands. A seventh species is known to us from a single ♂ specimen which most closely resembles *V. ternatica*; however, its locality, given on the data label as 'Japan', is regarded as erroneous and the species is described without being named in this paper.

The *pyraliata*-group includes seven species. The most widely distributed is *V. pyraliata*, which ranges from Sri Lanka to the Philippines, Sulawesi and Flores, in three subspecies. *V. pyraliata latialbata* has the widest range. It occurs in the Malay Peninsula, Sumatra, Java, Borneo and part of Sulawesi; there are dubious records from Sri Lanka and Australia. The rather similar *V. pyraliata triangulifera* replaces it in the Philippines. The more divergent nominate subspecies is found in part of Sulawesi and in Flores. The remaining species of the group have restricted ranges. *V. nicobarica* is restricted to the Nicobar Islands. Four vicarious species, *V. muluana*, *kolakalis*, *sulaensis* and *gemina*, occur in Sarawak, Sulawesi, Sula Besi and the Schouten Islands, Geelvink Bay, respectively. *V. splendida* lives sympatrically with *V. pyraliata triangulifera* in the Philippines.

The single species of the *plumosa*-group is geographically variable. It extends through the Lesser Sunda Islands from just west of Wallace's Line in Bali to Dammer Island; a distinct subspecies is found in Salajar, off the south coast of Sulawesi. Although we include all the populations from the Lesser Sunda Islands provisionally in the nominate subspecies, the limited material we have seen suggests that there may be geographical variation; specimens from the middle of the chain in Lombok and Sumbawa are large and dull-coloured, whereas those from Bali in the west and from the eastern islands of the group are smaller and brighter. More material is needed before these differences can be evaluated.

The *suradeva*-group has two species. *V. teleroma* ranges from Perak to Borneo; there is some variation in this species which more material may show to be geographically based. *V. suradeva* has two subspecies. One ranges from W. Bengal and Assam to Burma, Thailand and Vietnam, the other is found in southern India and in Sri Lanka.

There appear to be two possible interpretations of the geographical distribution of the *Vitessa* complex. On the one hand, the concentration of species and species-groups in the Papuan region

may be taken as evidence that the complex has originated and undergone most of its evolution there, and that it has spread secondarily into the Indo-Malayan region. Alternatively, it may be supposed that the groups now confined to the Papuan region were previously widespread, but that they have been displaced in the west by the species that now exist there. On either hypothesis it must be assumed that there has been active local differentiation in most of the surviving species-groups.

NOMENCLATURE. The genus has mostly been cited as *Vitessa* Moore. However, the name was changed to *Cosmethis* Hübner, [1820] in the BMNH collection many years ago, presumably by Hampson when he recognized the validity of Hübner's generic names, though Hampson (1896a : 145; 1896b : 502) had earlier used *Vitessa* in his published work on the genus. *Cosmethis* was used by Janse (1924; 1928) and by de Joannis (1930). The latter author designated *Phalaena zemire* Stoll as type-species of *Cosmethis*. However, this designation is antedated by that by Kirby (1892 : 498) of *Phalaena barbara* Stoll, 1781, now referred to the Geometridae. The name *Cosmethis* therefore cannot be applied to the present genus and the more familiar name *Vitessa* must be used.

Key to the species and subspecies of *Vitessa*

- | | | |
|---------|--|-----------------------------------|
| 1 | Hind wing upperside uniformly black, fringe white | 2 |
| – | Hind wing whitish buff, with or without broad black or fuscous terminal band | 17 |
| 2 (1) | Fore wing upperside greenish grey, with orange basal area outwardly bordered by fine blue-black subbasal fascia. New Guinea | <i>griseata</i> (p. 267) |
| – | Fore wing with fascia in medial area | 3 |
| 3 (2) | Fore wing upperside with broad violet-grey medial fascia. New Britain | <i>brandti</i> (p. 269) |
| – | Fore wing with medial fascia other than violet-grey | 4 |
| 4 (3) | Fore wing upperside with large, square white medial fascia. Seram | <i>talboti</i> (p. 269) |
| – | Fore wing with more than one white marking in medial area | 5 |
| 5 (4) | Fore wing upperside with narrow white medial fascia divided into two spots. Ambon | <i>nobilis</i> (p. 270) |
| – | Fore wing with more than one fascia | 6 |
| 6 (5) | Fore wing upperside with two white transverse fasciae, sometimes joined by medial diffusion; basal area orange | 7 |
| – | Fore wing with two pale yellow transverse fasciae, always separated; subbasal area orange | 16 |
| 7 (6) | Fore wing upperside with postmedial fascia joining white terminal lines (<i>cyanea</i> sub-species) | 8 |
| – | Fore wing with postmedial fascia not joining white terminal lines (<i>zemire</i> subspecies) | 9 |
| 8 (7) | Fore wing upperside with orange basal area not passing <i>Cu</i> ; ♂ genitalia with termen of valve narrowly rounded. Seram | <i>cyanea ceramensis</i> (p. 273) |
| – | Fore wing with orange basal area indented at <i>Cu</i> but reaching posterior margin; ♂ genitalia with termen of valve truncated. Papua New Guinea and Fergusson Island | <i>cyanea cyanea</i> (p. 273) |
| 9 (7) | Fore wing upperside with wide creamy white postmedial fascia, width nearly equal to half width of wing at centre; antemedial fascia narrower than subbasal fascia; basal area complete. Northern Moluccas | <i>zemire expansa</i> (p. 275) |
| – | Fore wing with markings not as above | 10 |
| 10 (9) | Fore wing upperside with wide chalky white postmedial fascia, width equal to half width of wing at centre; antemedial fascia narrower than subbasal fascia; basal area indented; hind wing underside with white apical area. Southern Moluccas | <i>zemire zemire</i> (p. 276) |
| – | Fore wing with markings not as above | 11 |
| 11 (10) | Fore wing upperside with antemedial fascia diffused medially but not joining postmedial fascia, as wide as subbasal fascia; width of postmedial fascia more than half width of wing at centre. New Guinea and coastal islands | <i>zemire temerata</i> (p. 276) |
| – | Fore wing with medial diffusion of fasciae joining, or fasciae well separated | 12 |
| 12 (11) | Fore wing upperside with antemedial fascia irregularly diffused medially, meeting diffusion from postmedial fascia, especially along posterior margin. Queensland | <i>zemire nephritica</i> (p. 278) |
| – | Fore wing with fasciae well separated, without such diffusion | 13 |

- 13 (12) Fore wing upperside with orange basal area bearing subcostal black dot half width of eye; postmedial fascia twice as wide as antemedial fascia in ♂, antemedial fascia in ♀ reduced to hair-line. Umboi Island *zemire coronis* (p. 278)
 – Fore wing with markings not as above 14
- 14 (13) Fore wing upperside with subcostal black dot half width of eye or much less; both white fasciae reduced in width, postmedial fascia one-third width of wing at centre. New Britain and New Hannover *zemire novaebritanniae* (p. 279)
 – Fore wing similar to above; hind wing underside lacking white apical area but having white spot at apex of cell 15
- 15 (14) Fore wing upperside with orange basal area indented at A_1 with blue-black; postmedial fascia narrow, less than half width of wing at centre. Solomon Islands *zemire solomonis* (p. 280)
 – Fore wing with postmedial fascia broad, equal to half width of wing at centre. New Hebrides *zemire cheesmanae* (p. 280)
- 16 (6) Fore wing upperside with postmedial fascia directed towards posterior margin well basad of tornus, narrow, width less than half width of wing at centre. Fiji *virialis* (p. 281)
 – Fore wing with postmedial fascia directed towards tornus, broad, width equal to half width of wing at centre. Samoa *tamsi* (p. 283)
- 17 (1) Hind wing upperside with infuscation from costa reaching *CuP* or farther, eliminating white from cell; fore wing upperside with orange subbasal area reaching posterior margin. Borneo and Sumatra *heiratica* (p. 285)
 – Wings not with this combination of characters 18
- 18 (17) ♂ genitalia with anellus lacking catena spines; ♀ genitalia with corpus bursae lacking signum or small denticulate area 19
 – ♂ genitalia with anellus bearing catena spines; ♀ genitalia with corpus bursae bearing signa or small denticulate areas 22
- 19 (18) Fore wing above with about six white terminal lines; ♀ genitalia with funnel-shaped antrum (♂ unknown). Philippines *philippina* (p. 286)
 – Fore wing with more than six white terminal lines; ♀ genitalia with cup-shaped antrum 20
- 20 (19) Fore wing upperside with postmedial and antemedial fasciae broad and complete. New Guinea *stettina* (p. 287)
 – Fore wing upperside with both fasciae narrow, incomplete or indented 21
- 21 (20) Fore wing underside with postmedial fascia divided into two spots. Sulawesi *hollandi wallacealis* (p. 289)
 – Fore wing with postmedial fascia a single large oval spot. New Guinea *hollandi hollandi* (p. 290)
- 22 (18) ♂ genitalia with clasper on valve long, strap-shaped and serrulate along part or whole of free edge; ♀ genitalia with ductus seminalis arising below or just above base of antrum 23
 – ♂ genitalia with clasper short, mostly parallel to posterior margin, free edge with small ridge and rounded scoop-like process; ♀ genitalia with ductus seminalis arising mid-way up swollen extended base of antrum (*suradeva*-group) 42
- 23 (22) ♂ genitalia with clasper with large ridges or tooth-like points at posterior margin with pronounced acuminate ridges mid-way; ♀ genitalia with posterior portion of antrum trapezoidal, or broadly extended and cup-shaped anteriorly 24
 – ♂ genitalia with clasper with pronounced truncate process mid-way; ♀ genitalia with antrum broadly rounded posteriorly, acutely funnel-shaped anteriorly with V-shaped dorsal crease (*plumosa*-group) 41
- 24 (23) Fore wing upperside with antemedial fascia reduced to minute spot on costa and larger narrow triangular spot on *Cu* pointing medially; hind wing upperside with white area reduced to a comma-shape directed basally. Moluccas *ternatica* (p. 292)
 – Combined fore wing and hind wing markings not as above 25
- 25 (24) Fore wing upperside with postmedial fascia divided into two spots with terminal margins at right-angles to posterior margin of wing. Moluccas *hemiallactis moluccana* (p. 295)
 – Fore wing with postmedial fascia divided into two spots or complete but terminal margins oblique to posterior margin 26
- 26 (25) Fore wing upperside with postmedial and antemedial fasciae indented or complete, fasciae approaching but not joining at any point. New Guinea *hemiallactis hemiallactis* (p. 296)

- Fore wing with postmedial and sometimes antemedial fascia distinctly divided into two or more spots, or fasciae complete and partially fusing 27
- 27 (26) Fore wing upperside with antemedial fascia narrowing almost to a hair-line but not divided; postmedial fascia with two spots; hind wing upperside with broad black terminal band. Admiralty Islands *hemiallactis admiralitatis* (p. 297)
- Fore wing with antemedial fascia narrow, or broad, or divided into two spots; postmedial fascia divided into two or more spots, or complete; hind wing upperside wholly creamy white or with black terminal band 28
- 28 (27) Hind wing upperside with large oval white area not reaching anal margin; fore wing upperside with terminal white lines well apart from postmedial fascia. Bismarck Archipelago *hemiallactis lustrans* (p. 298)
- Hind wing with white area reaching anal margin except where white almost obliterated by infuscation encroaching from costa; fore wing with terminal white lines separate from or joining postmedial fascia 29
- 29 (28) Fore wing upperside with fasciae partially fusing leaving variable amounts of blue-black medial fascia exposed; orange subbasal area reduced leaving blue-black subbasal fascia broad at costa. Papua New Guinea *intermedia* (p. 299)
- Fore wing with fasciae more completely fused, or quite separated and divided into spots 30
- 30 (29) Fore wing upperside with fasciae almost completely fused leaving medial fascia as a longitudinal short streak; expanse of fore wings 60 mm or over. Papua New Guinea *barretti* (p. 300)
- Fore wing with fasciae similar, but fore wing expanse less, or fasciae separated 31
- 31 (30) Fore wing upperside with fasciae almost completely fused leaving medial fascia as a short triangular spot; expanse of fore wings 50 mm or less. Queensland *glaucoptera* (p. 301)
- Fore wing with fasciae separated and divided into spots 32
- 32 (31) Fore wing underside with white terminal lines present from R_4 to A_{1+2} . San Cristobal Island *cristobalensis* (p. 302)
- Fore wing with white terminal lines absent or from R_4 to Cu_1 33
- 33 (32) Hind wing upperside of ♂ unicolorous whitish buff, of ♀ mainly whitish buff, with narrow and ill-defined black costal and terminal borders. Nicobar Islands *nicobarica* (p. 303)
- Hind wing of ♂ and ♀ with broad well-defined black costal and terminal borders 34
- 34 (33) Hind wing upperside with white extending along over half of anal margin; fore wing upperside with lower spot of antemedial fascia distinctly rectangular. Malaysia *pyraliata latialbata* (p. 306)
- Hind and fore wing markings other than in above combination 35
- 35 (34) Fore wing upperside with orange subbasal area restricted between Sc and A_{1+2} ; hind wing upperside with white extending along half of anal margin. Philippines *pyraliata triangulifera* (p. 308)
- Fore and hind wing markings other than in above combination 36
- 36 (35) Hind wing upperside with white variably extended and restricted along anal margin, from a third to complete restriction; fore wing upperside with orange subbasal area from just above Sc to A_{1+2} ; patagium mostly black. Sulawesi *pyraliata pyraliata* (p. 308)
- Hind and fore wing markings and colour of patagium other than in above combination 37
- 37 (36) Hind wing upperside with white variably extended along anal margin from half to about a third; fore wing upperside with orange subbasal area to within hair-line of costa; patagium mostly orange. Sulawesi *kolakalis* (p. 309)
- Hind wing with white extending along half or more of anal margin 38
- 38 (37) Fore wing upperside with orange subbasal area not passing A_{1+2} ; white terminal vein-lines very short. Moluccas *sulaensis* (p. 310)
- Fore wing with subbasal area nearly reaching posterior margin 39
- 39 (38) ♀ genitalia with corpus bursae with two round, depressed denticulate signa (♂ unknown). Sarawak, Sabah *muluana* (p. 311)
- ♀ genitalia with corpus bursae with minute denticulate patches 40
- 40 (39) ♀ genitalia with antrum funnel-shaped (♂ unknown). Schouten Islands, Geelvink Bay *gemina* (p. 312)
- ♀ genitalia with antrum deep and cup-shaped (♂ unknown). Philippines *splendida* (p. 313)
- 41 (23) Hind wing upperside with black border along termen narrowing abruptly before reaching tornus. Sumbawa *plumosa plumosa* (p. 316)

- Hind wing with black border narrowing evenly from costa to tornus. Salajar
plumosa salayerensis (p. 317)
- 42 (22) Fore wing upperside with antemedial fascia finely parted at cell. Malaysia . *teleroma* (p. 317)
- Fore wing with antemedial fascia indented but complete 43
- 43 (42) ♂ genitalia with aedeagus with right cluster of cornuti about half as long as left; ♀ genitalia
with antrum nearly as wide as long. Northern India to Vietnam *suradeva suradeva* (p. 320)
- ♂ genitalia with right cluster of cornuti noticeably smaller, about one-third as long as left;
♀ genitalia with antrum much narrower than long. Southern India and Sri Lanka
suradeva rama (p. 321)

The *griseata*-group

DIAGNOSIS. Fore wing above: mostly greenish, with or without a broad, diffuse, violet-grey transverse medial fascia but without a distinct black wedge-shaped discocellular dot or dash or narrow transverse medial fascia as in greenish-winged species of the *zemire*- and *hemiallactis*-groups; or fore wing above: largely black, with complete or interrupted whitish transverse medial fascia, without postmedial and antemedial fasciae as in other species-groups. Hind wing black, as in *zemire*-group. Genitalia in ♂ with uncus narrowly pyriform, a short zone of oblique, close-set setae dorsolaterally, as in the *hieratica*-group, but with setae less differentiated; valve falcate, with small, central, almost vestigial clasper, not ridge-like or projecting marginal clasper as in other species-groups; anellus with large lateral clusters of spines as in *zemire*-group. Genitalia in ♀ with weakly developed spined setae on ovipositor lobes; posterior ostial sclerite bearing two lateral bullae; anterior margin of anterior sclerite strongly wrinkled; antrum sclerotization short; anterior end of ductus bursae membranous, broadly funnel-shaped; corpus bursae with two round, depressed, denticulate signa.

Vitessa griseata Kenrick, 1907

(Figs 4, 25, 33, 52, 53, 138, 173, 204, 226, 316)

Vitessa griseata Kenrick, 1907, *Proc. zool. Soc. Lond.* **1907** : 75, pl. 3, fig. 45. LECTOTYPE ♂, NEW GUINEA: Papua, Dinawa, 4000 ft [1200 m], ix.1902 (*A. E. Pratt*) (BMNH), here designated [examined]. *Cosmethis griseata* (Kenrick); Janse, 1928 : 88.

♂, ♀. 44–68 mm. Frons pale orange. Vertex bright orange. Eye dark brown. Ocellus weak, not conspicuous, dark brown. Chaetosema with pale yellowish setae. Antenna dark fuscous, anterior surface of scape and basal segment orange; posterior surface of apical third of shaft white. Labial palpus blackish fuscous; orange on ventral surfaces of first and second segments, minute amount at base of third. Maxillary palpus orange. Basal scaling of proboscis black, admixed with orange at base. Neck region orange. Thorax above: orange; patagium and tegula orange, each with blue-black spot at centre. Abdomen above: black; narrow whitish grey posterior line on each segment, anal tuft orange. Body below: black with bluish reflections; pectus with considerable orange scaling; whitish grey abdominal lines wider than above; anal tuft orange. Legs blackish fuscous, with extensive pale grey scaling on coxae, femora and tibiae. Fore wing above: basal area orange bearing two black spots on *R*, some black posteriorly; oblique subbasal fascia a blue-black line. Remainder of wing silky greenish grey, with fine black terminal lines, mostly between veins, from *R* to *Cu*, variable in number. Fringe anteriorly black, posteriorly pale grey. Hind wing above: black with some metallic lustre. Fringe: base grey, terminally whitish grey, anal margin black. Fore wing below: black, slightly metallic; an oblique, oblong, cream-coloured postmedial fascia, almost reaching posterior margin; apex with diffuse longitudinal greenish grey lines; fringe dark grey anteriorly, whitish grey posteriorly; retinaculum dark grey. Hind wing below: similar to fore wing but with fringe uniformly whitish grey.

GENITALIA ♂ (Figs 25, 33, 138, 173, 204). Uncus relatively short and wide, base constricted, basal part laterally convex with ventral foramen; distal part flattened, curved, acuminate, with a dorsolateral zone of oblique setae. Gnathos with flattened, medially decurved, wide lateral arms and with compressed, basally straight, distally upturned and acuminate, medial process. Transtilla shallowly V-shaped, of even width. Tegumen with medially broadened posterior sclerite and with anterior sclerite widely emarginated medially. Vinculum ventrally narrow and flattened. Valve long and narrow, distally falcate, extreme tip very narrowly rounded and terminal margin excised before it; costa strongly inflated; mesal surface of valve heavily setose in distal two-thirds of costal region only; clasper a small erect three-sided ridge at axis of valve, less than half valve length from base. Juxta with nearly rectangular lateral sclerites,

each bearing a dorsal, somewhat decurved, thorn-shaped, thinly setose process and ventral, slender, ribbon-shaped process, ventral process directed posteriorly and nearly reaching mid-line, supporting base of anellus; anellus (Figs 33, 173) arising from juxta processes with large lateral, medially directed sclerite bearing large anteriorly directed spines, sclerite connected directly to dorsal process (Fig. 25); ventral surface of anellus between the sclerites longitudinally rugose, lightly sclerotized and centrally spinose; dorsal surface with medial catena (Fig. 33) consisting of an elongated, ovoid area, minutely spinose; most of manica supported by dorsal sclerotized caliper-shaped bands, narrowing and less sclerotized towards tip. Aedeagus of moderate length, expanded distally, slightly curved, base narrowly rounded; ductus ejaculatorius arising basad of middle; scale-like spines extending medially for a short distance from vesica along dorsal and ventral surfaces of aedeagus; base of vesica bulbous dorsally at posterior end of aedeagus; dorsal and ventral surfaces covered with scale-like spines from base of vesica to about half-way along larger cornuti clusters, the spinose area longitudinally rugose between cornuti clusters; vesica bulbous immediately distad of this region. Cornuti (Fig. 204) grouped in three clusters of spines: two large, more basal, dorsolateral clusters of unequal size, the left one longer and extending farther distad than the right, and a much smaller, distal, mid-ventral cluster, bearing thinner spines and arising from distal end of an oblique sclerotized band.

GENITALIA ♀ (Figs 226, 272, 316). High, wide ovipositor lobes, dorsally fused and produced posteriorly; surface densely setose, margin with row of well-separated longer setae; spiny setae not easily seen (Fig. 316). Posterior apophysis fairly long, slender, weakly curved, with spatulate tip. Anterior apophysis similar but longer. Posterior ostial sclerite (Fig. 272) broadly sclerotized, posterior margin angularly excised, anteromedial part broadly divided on mid-line by a narrow sulcus, laterally a pair of wrinkled bullae with sinuate, posteriorly converging inner margins, posteriorly denticulate. Anterior sclerite narrow, wrinkled, reflected, heavily denticulate. Antrum short, collar-shaped. Ductus bursae membranous, posteriorly widened and flattened, lightly sclerotized. Corpus bursae globular, membranous, with a pair of large, heavily sclerotized, depressed, denticulate signa.

REMARKS. This species is fairly common at most altitudes in many parts of New Guinea. The only sympatric species with which it might be confused is *V. barretti*, which can be separated by the black discocellular spot of its fore wing and the large white area on the hind wing. The closest relative of *V. griseata* is *V. brandti* from New Britain, which has a contrasting violet-grey transverse medial fascia on the upperside of the fore wing.

BIOLOGY. Early stages and host-plant unknown. Moths collected by many collectors in most months of the year.

DISTRIBUTION (Fig. 4). New Guinea: Irian Jaya; Papua New Guinea, 500–2150 m.

MATERIAL EXAMINED

Paralectotypes. 6 ♂, 2 ♀, data as lectotype (genitalia slide no. 15286; BMNH; CMAG, Birmingham).

New Guinea: 1 ♂, 3 ♀, Irian Jaya, C. Arfak Mts, Ninay Valley, 1050 m, xi.1908–i.1909 (*A. E. Pratt*) (BMNH); 1 ♂, 3 ♀, I. J., Arfak Mts, 1200 m, ii–iii.1909 (*C. B. Pratt*) (BMNH; CMAG, Birmingham); 1 ♀, I. J., Arfak Mts, 1850 m, iii.1910 (*C. B. & F. B. Pratt*) (BMNH); 1 ♀, I. J., Snow Mts, Setekwa R., ix.1910 (*Meek*) (BMNH); 8 ♀, I. J., Snow Mts, Upper Setekwa R., 600–1050 m, ix.1910 (*Meek*) (BMNH); 2 ♀, I. J., Snow Mts, nr Oetakwa R., up to 1050 m, x–xii.1910 (*Meek*) (BMNH); 2 ♂, 11 ♀, I. J., Mt Goliath, 1500–2150 m, about 139° long. [4°40' S 139°52' E], i–ii.1911 (*Meek*) (BMNH; NMNH, Washington); 2 ♂, 2 ♀, Papua New Guinea, Sepik District, Telefomin (Eliptamin), 1350–1700 m, vi–ix.1959 (*Brandt*) (ANIC, Canberra); 1 ♂, 3 ♀, P. N. G., Sepik District, Bainyik, 300 m, x.1957 (*Munroe & Holland*) (CNC, Ottawa); 1 ♀, P. N. G., Western Highlands, Jimi R., 1450 m, vii–ix.1961 (*Brandt*) (ANIC, Canberra); 5 ♂, 1 ♀, P. N. G., Finisterre Range, Kiambari, 1350 m, vii–viii.1958 (*Brandt*) (ANIC, Canberra); 1 ♀, P. N. G., Madang District, Finisterre Mts, Naho R. Valley, Budemu, 1250 m, x.1964 (*Bacchus*) (BMNH); 2 ♂, 8 ♀, P. N. G., Morobe District, Finisterre Mts, Wantoat, 1200 m, ix.1957 (*Munroe & Holland*) (CNC, Ottawa); 3 ♀, P. N. G., Gurukor, 600 m, ii.1978 (*Hébert*) (CNC, Ottawa); 8 ♀, P. N. G., Morobe District, near Bulolo, *Araucaria* forest, 1200 m, ix.1957 (*Munroe & Holland*) (CNC, Ottawa); 1 ♀, P. N. G., Morobe District, Edie Creek, 2050 m, ix.1957 (*Munroe & Holland*) (CNC, Ottawa); 8 ♀, P. N. G., Bulldog Rd, 3 km S. Edie Creek, 2200 m, viii.1975 (*Hébert & Ward*) (CNC, Ottawa); 1 ♀, P. N. G., same locality, xii.1977 (*Hébert & Harmsen*) (CNC, Ottawa); 5 ♀, P. N. G., Eastern Highlands, Okapa, 1850 m, x.1957 (*Munroe & Holland*) (CNC, Ottawa); 44 ♂, 9 ♀, P. N. G., Dinawa, 1200 m, ix.1902 (*A. E. Pratt*) (BMNH; NMNH, Washington); 11 ♂, 22 ♀, P. N. G., Mt Kebea, 1100 m, and 1850 m, iii–viii.1903 (*A. E. Pratt*) (BMNH; CMAG, Birmingham; NMNH, Washington); 4 ♂, 4 ♀, P. N. G., Upper Aroa R., iii–iv.1903 (*Meek*) (BMNH); 5 ♀, P. N. G., Mafalu [sic], 1850 m, viii.1903 (*A. E. Pratt*) (BMNH); 1 ♂, 2 ♀,

P. N. G., Mafulu, 1200 m, i.1934 (*Cheesman*) (BMNH); 3 ♀, P. N. G., Avola, 1850 m, viii.1903 (*A. E. Pratt*) (BMNH); 2 ♀, P. N. G., Babooni, 1100 m, ix.1903 (*A. E. Pratt*) (BMNH); 1 ♀, P. N. G., Angabunga R., afflu[ent] of St Joseph R., 1850 m upwards, xi.1904–ii.1905 (*Meek*) (BMNH); 2 ♂, 3 ♀, P. N. G., Tapini, Loloipa R., Bome, 1900 m, ii–v.1958 (*Brandt*) (ANIC, Canberra); 13 ♂, 19 ♀, P. N. G., Sogeri Plateau, Bisianumu, 500 m, viii.1957 (*Munroe & Holland*) (CNC, Ottawa); 26 ♂, 60 ♀, P. N. G., Sogeri Plateau, Mageri, viii.1957 (*Munroe & Holland*) (CNC, Ottawa); 10 ♂, 11 ♀, P. N. G., Mambare R., Biagi, 1500 m, i–iv.1906 (*Meek*) (BMNH; MNHN, Paris; NMNH, Washington); 8 ♂, 1 ♀, P. N. G., Hydrographer Mts, 750 m, i–iii.1918 (*Eichhorn Bros.*) (BMNH); 1 ♂, 1 ♀, P. N. G., Amazon Bay area, Doveta, 750 m, vii–ix.1962 (*Brandt*) (ANIC, Canberra); 1 ♂, 1 ♀, no data (CMAG, Birmingham).

***Vitessa brandti* sp. n.**

(Figs 4, 54, 137)

♂. 54 mm. Frons yellow. Vertex orange. Eye and ocellus brown. Chaetosema with pale yellowish setae. Antenna dark fuscous; posterior surface of apical third of shaft white. Labial palpus black, orange on ventral surfaces of first and second segments, third segment entirely black. Maxillary palpus orange. Basal scaling of proboscis black. Neck region orange. Thorax above: orange; patagium orange with posteromesal blue-black spot; tegula orange with similar anterolateral spot. Abdomen above: blue-black, narrow white terminal line on each segment, anal tuft orange. Body below: blue-black; pectus orange; whitish grey terminal abdominal lines, anal tuft orange. Legs blue-black, mid coxa and mid and hind femora with whitish grey scales; hind tibia with shaggy black scales dorsally on basal half. Fore wing above with basal area orange, bearing single small basal blue-black spot and two larger subbasal spots, posterior spot diffuse; subbasal fascia erect, fairly wide, glossy blue-black, sharply defined on both sides. Antemedial fascia a narrow area of jade green, diffuse medially and followed by a broad violet-grey medial fascia, slightly expanded posteriorly. Terminal part of wing jade green with wide black stripes and narrow wedges between veins. Costa narrowly black from base to apex. Fringe black, grey towards tornus. Hind wing above: blue-black with metallic lustre. Fringe fuscous, distal half whitish grey, anal margin black. Fore wing below: blue-black; oval postmedial patch white; faint light grey streaks on a few veins subapically. Hind wing below: like upperside, but with veins of subapical region broadly jade green.

♀. Unknown.

GENITALIA ♂ (Fig. 137). In general as for *V. griseata* (p. 267). Uncus broad, gradually tapering from convex base, slightly waisted. Transtilla very shallowly V-shaped. Valve relatively short and broad, distally falcate, extreme tip narrowly rounded; terminal margin at right angles to costa, becoming broadly rounded before forming posterior margin; clasper more than half valve length from base. Aedeagus base broadly rounded.

REMARKS. This species is similar in general appearance to *V. griseata*, but is separated externally by the broad violet-grey medial fascia on the fore wing, and by the larger spots on the patagium and tegula. In the ♂ genitalia the broader uncus and the relatively short, broad and truncated appearance of the valve separate this species from *V. griseata* and *V. talboti*. We take pleasure in dedicating this species to Mr W. Brandt, collector of the holotype and of many other interesting Papuan Lepidoptera.

BIOLOGY. Early stages and host-plant unknown. Holotype collected some time between June and September.

DISTRIBUTION (Fig. 4). Bismarck Archipelago: New Britain.

MATERIAL EXAMINED

Holotype ♂, **New Britain**: Mt Sinewit, 1050 m ('3500 ft'), 27.vi.–17.ix.1963 (*Brandt*) (genitalia slide no. DK 738; ANIC, Canberra).

***Vitessa talboti* (Janse, 1924) comb. n.**

(Figs 4, 55, 56, 139, 174, 227, 273)

Cosmethis talboti Janse, 1924, *Bull. Hill Mus. Witley* 1: 503. LECTOTYPE ♂, MOLUCCAS: Central Ceram [Seram], Manusela [3°15' S, 129°38' E], 1850 m ('6000 ft'), x–xii.1919 (C., F. & J. Pratt) (genitalia slide no. 14676/a, Shaffer; TM, Pretoria), here designated [examined].

♂, ♀. 50–56 mm. Frons orange. Vertex orange with a few medial black scales. Eye and ocellus brown. Chaetosema with pale yellowish setae. Antenna black; posterior surface of apical third of shaft white.

Labial palpus black, orange on ventral surfaces of first and second segments, third segment entirely black. Maxillary palpus orange, inner surface black. Basal scaling of proboscis brownish fuscous, a slight sprinkling of orange at extreme base and on sides. Neck region orange. Thorax above: orange; patagium orange with a posteromesal blue-black spot; tegula orange with diffuse anterolateral blue-black spot. Abdomen above: blue-black, a narrow whitish grey terminal line on each segment, anal tuft orange. Body below: black; pectus orange; abdomen black, a whitish grey terminal line on each segment, wider than on dorsal surface; anal tuft orange. Legs black; whitish grey scaling on coxae, ventral surfaces of femora, tips of mid and hind tibiae and bases of tibial spurs; hind tibia with shaggy black scales dorsally on basal half. Fore wing above: basal area orange, reaching *Cu*, bearing single large subbasal spot; broad subbasal fascia black with bluish green reflections; white square medial fascia, reaching posterior margin, postmedial border weakly oblique; costa narrowly black from apex to base, in ♂ costa anterior to medial fascia admixed with white; apical part of wing blue-black with whitish grey lining the veins, separate from medial fascia in ♂, almost touching in ♀; fringe dark grey, white at tornus. Hind wing above: blue-black with metallic reflections; fringe white admixed with grey, black at tornus and anal margin. Fore wing below: dull blackish fuscous; white medial fascia narrower, closer to apex than on upperside, antemedial margin irregular; apical region with traces of whitish grey; fringe as on upperside. Hind wing below: dull blackish fuscous; apical region with white vein-lines; fringe as on upperside.

GENITALIA ♂ (Figs 139, 174). In general as for *V. griseata*. Uncus broad, gradually tapering from convex base, slightly waisted. Anterior sclerite of tegumen triangular with keyhole-shaped medial anterior emargination. Vinculum broadly rounded. Valve long and extremely narrow, distally falcate, extreme tip very narrowly rounded and posterior margin deeply excised before it; clasper less than half valve length from base. Juxta with rectangular lateral sclerites, each bearing broadly triangular, blunted dorsal process, and long, slender, upturned ventral process; anellus (Fig. 174) with large, slightly sinuate, lateral sclerites bearing large anteriorly directed spines, anterolateral edge medially protruded, bearing long, more erect spines. Aedeagus base broadly rounded; ductus ejaculatorius subbasal. Cornuti: basal dorsolateral clusters of slightly unequal length, left one shorter than, but extending distad of, right.

GENITALIA ♀ (Figs 227, 273). In general as for *V. griseata*, see Remarks. Posterior sclerite of ostial chamber denticulate on lateral portions.

REMARKS. The almost square white medial fascia on the upperside of the fore wing makes this species quite distinct. Of the known males of this group, *V. talboti* has the most narrowly falcate valve. The ♀ genitalia resemble those of *V. griseata* and *V. nobilis*, differing only slightly; posterior apophysis slightly curved, thicker than in *V. griseata* and terminally truncated as in *V. nobilis*; anterior apophysis similar, differing from other species by being medially angled near base; lateral bullae on posterior sclerite smaller than in *V. griseata* but larger than in *V. nobilis*, differing also from both in that the inner margins are nearly parallel and touching; posteriorly widened ductus bursae smaller than in *V. griseata* and more nearly square, larger than in *V. nobilis*; ductus bursae and corpus bursae smaller than in *V. griseata* and *V. nobilis*; signa smaller than in *V. griseata* but larger than in *V. nobilis*.

BIOLOGY. Early stages and host-plant unknown. Moths collected between October and December.

DISTRIBUTION (Fig. 4). Moluccas: Seram.

MATERIAL EXAMINED

Paralectotypes. 1 ♂, 2 ♀, data as lectotype (1 ♀, abdomen missing; genitalia slide no.'s 14676/b, Shaffer, 14676; TM, Pretoria; BMNH) [1 ♀ syntype not seen].

Vitessa nobilis sp. n.

(Figs 4, 57, 228, 274)

♂. Unknown.

♀. 58 mm. Frons and vertex orange. Eye and ocellus brown. Chaetosema with pale yellowish setae. Antenna black, posterior surface of apical third of shaft white. Labial palpus [missing since time of description] black, first and second segments with considerable orange scaling basally and ventrally; third segment black, nearly as long as second. Maxillary palpus orange. Proboscis with black basal scaling. Neck region orange. Thorax above: orange; patagium black, laterally orange; tegula: black extending whole length, laterally orange. Abdomen above: black with grey terminal line on each segment, anal tuft orange. Body below: black; pectus black admixed with orange; abdomen black with wider grey terminal

lines on segments than above; anal tuft orange; legs black, whitish grey scaling on coxae, ventral surfaces of femora, tip of hind tibia. Fore wing above: black with metallic blue reflections; orange basal area completely divided, leaving minute basal area with larger subbasal area reaching *Cu*; costal area black from apex to base; wing veins bordered with greenish grey; medial fascia represented by a slightly post-medial, oblong, greenish grey patch on discocellular vein, and a diffuse bilobed greenish grey patch at middle of posterior margin; fringe black, with pale terminal scaling at tornus. Hind wing above: dull black with faint metallic reflections; fringe whitish grey, black at anal margin. Fore wing below: dull black with large, trapezoidal, whitish medial fascia; short whitish streak extending basally along *R* from anterolateral corner of fascia; faint traces of white vein-lines at apex; fringe as on upperside. Hind wing below: dull black; whitish grey vein-lines at apex; small greenish grey dash at angle of discocellular vein; fringe as on upperside.

GENITALIA ♀ (Figs 228, 274). In general as for *V. griseata*, see Remarks. Posterior sclerite of ostial chamber (Fig. 274) coarsely denticulate on lateral portions.

REMARKS. This species occurs sympatrically with *V. zemire* in Ambon. The fore wing is broader than in other species of the species-group; the upperside markings are completely distinct from those of all other species of *Vitessa*. The ♀ genitalia resemble those of *V. griseata* and *V. talboti*, but differ in the following characters: the posterior apophysis is thick and truncated as in *V. talboti* but straight; the anterior apophysis is long, slightly curved, thicker than in *V. griseata*, without basal angle as in *V. talboti*; the inner margins of the lateral bullae on the posterior wall of the ostial chamber diverge posteriorly, and do not converge medially as in *V. griseata*, or run parallel as in *V. talboti*; the anterior margin of the anterior sternite is recurved and deeply wrinkled as in *V. griseata*, more strongly wrinkled than in *V. talboti*; the ductus bursae is posteriorly widened and funnel-shaped as in *V. griseata* but narrower, not square as in *V. talboti*; the signa in the corpus bursae are smaller than in *V. griseata* or *V. talboti*.

BIOLOGY. Early stages and host-plant unknown. Holotype collected in November.

DISTRIBUTION (Fig. 4). Moluccas: Ambon.

MATERIAL EXAMINED

Holotype ♀, **Moluccas**: Ambon, Mt Salohotus, no. 17844, xi.1923 (*C. J. Brooks*) (genitalia slide no. 14697; BMNH).

The *zemire*-group

DIAGNOSIS. Hind wing above: black, as in *griseata*-group, but fore wing above with two transverse whitish fasciae on blackish ground colour, in addition to orange basal or subbasal patch and pale terminal vein-lines. ♂ genitalia with uncus slender or broadly flattened, decurved, with weakly differentiated distal portion bearing laterally directed setae; anellus with large lateral clusters of spines as in *griseata*-group; valve distally rounded or truncate, not falcate, fluted with oblique striations and mostly without clasper. ♀ genitalia more variable, with well-developed lateral, sclerotized, pouch-like invaginations beside ostial chamber, or twin bullae on posterior sclerite as in *griseata*-group; anterior margin of anterior sclerite strongly wrinkled; anteriorly extended antrum with conical or broadly flattened sclerotization, or antrum greatly reduced; corpus bursae with two round, depressed denticulate signa.

REMARKS. Within the *zemire*-group there are three subgroups: (1) *V. cyanea*, with ♂ genitalia like those of *V. zemire* and with ♀ genitalia similar to those of the *griseata*-group; (2) *V. zemire*, with valve in ♂ not bearing a clasper and with ♀ genitalia having the distinctive long flattened antrum; (3) *V. vitalis* and *V. tamsi*, where the ♂ has a long club-shaped clasper on a valve otherwise similar to that of *V. zemire*, and where the sclerotized antrum of the ♀ genitalia is greatly reduced or lacking.

Vitessa cyanea Hampson, 1906

(Figs 12, 34, 58–61, 140, 141, 175, 176, 205, 206, 229, 230, 275, 276)

Vitessa cyanea Hampson, 1906 : 217.

♂, ♀. 38–46 mm. Frons and vertex orange. Eye fuscous. Ocellus well developed, brown. Chaetosema with pale yellowish setae. Antenna black, some orange scaling at base of scape: posterior surface of apical

third in ♂ with some dark grey scaling. Labial palpus with first and second segments orange, second segment black dorsally, lightly admixed with orange; third segment black with some orange at base. Maxillary palpus orange with ventral black spot, some black scales admixed terminally. Basal scaling of proboscis black, lightly admixed with orange at extreme base. Neck region orange. Thorax above: orange; patagium orange with posteromedial blue-black spot; tegula orange with an anterolateral blue-black spot. Abdomen above: blue-black; terminal margins of most segments finely edged with white, broader laterally, last segment with terminal margin orange, acuminate blue-black at centre. Body below and laterally: blue-black; pectus orange; terminal margins of abdominal segments broadly white; last segment with terminal margin completely orange. Legs blue-black; base of fore coxa black, broadly bordered with orange; light grey scaling at base of fore femur and ventral surface of fore tibia with reddish white scaling on ventral surface of epiphysis. Fore wing rather narrow; above with basal area orange, strongly indented at regions of A_1 and A_2 , outer margin broadly curved, not reaching costa; single subbasal spot blue-black; subbasal, medial and terminal areas blue-black; creamy white antemedial fascia very narrow, sometimes incomplete, erect, not reaching costa or posterior margin, reduced to shorter hair-line in ♀; creamy white postmedial fascia large, oval, obliquely placed at end of cell, terminally extending into weak white terminal lines; fringe dark grey. Hind wing above: black with weak violaceous reflections; fringe dark grey apically, white towards anal margin, anal margin black. Fore wing below: black with violaceous reflections; postmedial fascia of similar proportions to that of upperside but without apical diffusion, diffusion stronger medially; posterior margin basally orange brown, medially white; fringe dark grey. Hind wing below: black with violaceous reflections; large white apical patch diffusing slightly along costa; fringe terminally white, anal margin black.

GENITALIA ♂ (Figs 34, 140, 141, 175, 176). Uncus slender, abruptly tapering from convex base, distal portion down-curved, then up-curved, with sparse scattering of long, laterally directed setae. Gnathos with flattened, medially angled, wide lateral arms and with compressed, basally straight, gently upturned and finely acuminate process. Transtilla V-shaped, medially broadened or narrowed. Tegumen with posterior sclerite short, wide; anterior sclerite with keyhole-shaped medial anterior emargination. Vinculum ventrally narrow, broadly rounded posteriorly. Valve long, widest at centre, distally finely or broadly truncated; costa basally inflated; many fine oblique striations on mesal surface, slightly stronger striations towards posterior margin. Juxta with two lateral sclerites, each bearing a dorsal bluntly triangular process, deeply recurved and sparsely setose, supporting base of anellus, and a ventral, posteriorly directed, slender, sinuate and acuminate process, tip nearly reaching mid line; anellus (Figs 175, 176) arising from dorsal processes of juxta, large lateral sclerites, anteromedially directed, bearing large anteriorly directed spines; on dorsal surface of anellus between anterior ends of lateral sclerites, an elongated, oval, medial catena (Fig. 34), consisting of a cluster of minute posteriorly directed spines; remainder of anellus just reaching medial catena, minutely spinose; manica supported by lightly sclerotized elongated bands continuous with lateral sclerites of anellus, narrowing towards tip. Aedeagus of moderate length, expanded distally, slightly curved, base narrowly rounded; ductus ejaculatorius subbasal; scale-like spines extending dorsally and ventrally for a short distance onto aedeagus from vesica; base of vesica bulbous ventrally at distal end of aedeagus; dorsal and ventral surfaces covered with scale-like spines from base of vesica to halfway along dorsolateral clusters of cornuti, the spinose areas longitudinally rugose. Two large basal lateral cornuti clusters of equal length, the left placed a little distad of the right; oblique posterior ventromedial cluster reduced to sclerotized bases (Figs 205, 206).

GENITALIA ♀ (Figs 229, 230, 275, 276). High, wide ovipositor lobes, dorsally fused and prolonged posteriorly, densely setose, setae longer on margin; spiny setae not easily seen. Posterior apophysis thick, curved, distally blunt and enlarged. Anterior apophysis thick, slightly curved, widened near base, distally blunt and enlarged. Posterior sclerite of ostial chamber (Figs 275, 276) broadly sclerotized, anteromedially broadly divided by a narrow sulcus, laterally a pair of wrinkled denticulate bullae with rounded, posteriorly converging inner margins. Anterior sclerite narrow, wrinkled, denticulate and reflected. Antrum short, wide. Ductus bursae membranous, posteriorly widened and flattened. Corpus bursae oval, membranous, with pair of large, heavily sclerotized, depressed, denticulate signa.

REMARKS. This species resembles *V. zemire* in general appearance, but has narrower wings and slighter build. The postmedial fascia on the upperside of the fore wing is clearly connected to the white terminal lines. The ♂ genitalia are like those of *V. zemire* but differ in having the valve distally truncate, not narrowly rounded, and with a more pronounced ridge in normal position of clasper. The catena is reminiscent of that of the *griseata*-group. The ♀ genitalia most clearly resemble the *griseata*-group in the structure of the sclerites around the ostial chamber, in the development of the lateral bullae divided by a sulcus, and in the shape and size of the antrum.

The ♀ genitalia differ in important characters from those of *V. zemire*, the ostial sclerites and antrum being very different in shape.

We recognize two subspecies from the following geographical areas: (1) southern Moluccas; (2) eastern New Guinea.

BIOLOGY. Early stages and host-plants unknown. Moths collected from January to March, September to December.

DISTRIBUTION (Fig. 12). Southern Moluccas: Seram. New Guinea: Papua New Guinea. D'Entrecasteaux Islands: Fergusson Island.

Vitessa cyanea ceramensis subsp. n.

(Figs 12, 58, 59, 140, 175, 205, 229, 275)

♂, ♀. 38–46 mm. Generally as described for species. Fore wing above with white postmedial fascia broadly reaching main stem of *R* in ♂; in ♀ anteromedial corner of postmedial fascia protruded basally into cell. White antemedial fascia in ♀ narrow and complete but not reaching costa or posterior margin, diffuse medially.

GENITALIA ♂ (Figs 140, 175, 205). Generally as described for species. Uncus slender, gently tapering. Transtilla V-shaped and medially narrow. Valve widest a little beyond centre, distally finely truncated. Anellus (Fig. 175) with dorsal medial catena oval.

GENITALIA ♀ (Figs 229, 275). Generally as described for species, but see Remarks.

REMARKS. The specimens are externally in poor condition, especially the ♂. The fore wing above has the postmedial fascia broader than in the nominate subspecies and, in the ♀ at least, the antemedial fascia is broader. In the ♂ there is virtually no sign of the antemedial fascia or orange basal area, probably due to wear. The ♂ genitalia are distinguished from those of the nominate subspecies by the narrower uncus, somewhat narrower transtilla, broader valve with narrower apical truncation, shorter medial catena and shorter cornuti clusters. The ♀ genitalia are distinguished by the smaller, not distally enlarged apophyses, smaller bullae on the posterior ostial sclerite (Fig. 275), smaller corpus bursae and larger signa. The genital differences are considerable, and may prove to be of specific value.

BIOLOGY. Early stages and host-plant unknown. Allotype collected in December.

DISTRIBUTION (Fig. 12). Southern Moluccas: Seram.

MATERIAL EXAMINED

Holotype ♀, **Moluccas**: Seram ('Ceram'), 'Jllo', 1901 (*Coll. E. L. Ragonot*) (genitalia slide no. 15302/a, Shaffer; MNHN, Paris).

Paratype. **Moluccas**: 1 ♂ (allotype), Central Ceram, 29.20, 3000 ft [900 m], xii.1919 (*C. F. & J. Pratt*) (genitalia slide no. 15302/b, Shaffer; TM, Pretoria).

Vitessa cyanea cyanea Hampson, 1906

(Figs 12, 34, 60, 61, 141, 176, 206, 230, 276)

Vitessa cyanea Hampson, 1906, *Ann. Mag. nat. Hist.* (7) 17: 217. Holotype ♂, D'ENTRECASTEAUX ISLANDS: Fergusson I., x.1894 (*Meek*) (BMNH) [examined].

♂, ♀. 40–46 mm. Generally as described for species. Fore wing above with white postmedial fascia narrowly reaching main stem of *R* veins in both sexes, medial margin broadly rounded. White antemedial fascia in ♀ and sometimes in ♂ reduced to a hair-line.

GENITALIA ♂ (Figs 34, 141, 176, 206). Generally as described for species. Transtilla medially broadened. Valve apex broadly truncated. Medial catena (Figs 34, 176) with additional smaller lateral patches.

GENITALIA ♀ (Figs 230, 276). As described for species.

REMARKS. The distinguishing features from *V. cyanea ceramensis* are given under that subspecies.

BIOLOGY. Early stages and host-plant unknown. Moths collected from January to March, September to December.

DISTRIBUTION (Fig. 12). New Guinea: Papua New Guinea. D'Entrecasteaux Islands: Fergusson Island.

MATERIAL EXAMINED

New Guinea: 8 ♂, Papua New Guinea, Hydrographer Mts, 750 m, i-iii.1918 (*Eichhorn Bros.*) (BMNH).
D'Entrecasteaux Islands: 2 ♂, 1 ♀, Fergusson I., ix-xii.1894, xii.1914 (*Meek*) (BMNH).

Vitessa zemire (Stoll, [1781])

(Figs 5-9, 26, 62-77, 142-148, 177-182, 207, 208, 231-238, 277-284, 317)

Phalaena zemire Stoll, [1781]: 149, pl. 367, fig. 1.

♂, ♀. 37-62 mm. Frons and vertex orange. Eye and ocellus fuscous. Chaetosema with pale yellowish setae. Antenna black; anterior surface of scape orange; posterior surface of apical third of shaft white to variable extent; terminal segments sometimes black. First and second segments of labial palpus either with ventral and lateral surfaces orange, dorsal surfaces black, or completely orange; third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis black, admixed with orange at extreme base. Neck region orange. Thorax above: orange; patagium with large, posteromedial, metallic blue-black spot; tegula orange, with anterolateral metallic blue-black spot varying in length. Abdomen above: matt black, a narrow whitish grey terminal line on most segments, posterior half of terminal segment and anal tuft orange. Body below and laterally: blue-black; pectus orange; whitish grey abdominal lines wider than above; posterior half of terminal segment and anal tuft orange. Legs black; tibiae with metallic green reflections; variable amounts of whitish grey on some parts; anterior end of upper surface of hind tibia with long black scales. Fore wing rather wide; above: basal area orange, outer margin straight, slightly sinuate to greatly indented at *A*, oblique, bearing small black subbasal spot; ground colour black with metallic blue or green reflections; subbasal fascia variable in width, glossy blue-black; white or greenish white, parallel, somewhat oblique, antemedial and postmedial transverse fasciae of variable width, sometimes irregularly extended towards each other, rarely joining, the postmedial fascia always the broader; whitish vein-lines in terminal and apical regions; fringe fuscous with bronze gloss at intervals. Hind wing above: black with violaceous reflections; fringe glossy fuscous, whitish grey towards anal margin. Fore wing below: blue-black; single white postmedial fascia present, of variable width; posterior margin basally orange brown, medially white; retinaculum dark grey. Hind wing below: blue black; variable amount of white in apical region, either solid or consisting of wide bars on veins; sometimes a white discal spot present; fringe wholly grey or white.

GENITALIA ♂ (Figs 26, 142-148, 177-182, 207, 208). Uncus slender, gradually tapering, distal portion down-turned then up-turned, with sparse scattering of long, laterally directed setae. Gnathos with flattened, medially angled, wide lateral arms and with compressed, basally straight, but dorsoventrally widened, up-turned and sickle-shaped, acuminate medial process. Transtilla shallowly V-shaped and medially narrowed or of even width. Tegumen with posterior sclerite short and wide, anterior sclerite widely emarginated medially. Vinculum ventrally broad and basally convex. Valve long, widest at centre, distally tapering to a narrowly rounded apex; costa inflated; some oblique striations on ventral surface, clasper absent. Juxta with lateral sclerites chelate, each bearing a dorsal, bluntly triangular and thickly setose process and a ventral, slender, straight and acuminate process nearly reaching mid-line, supporting base of anellus. Anellus (Figs 177-182) with large lateral sclerites, strongly angled medially, bearing large anteriorly directed spines, sclerite connected directly to dorsal process (Fig. 26); ventral surface of anellus above lateral sclerite longitudinally rugose and lightly sclerotized, not spinose medially; medial catena absent; manica supported by dorsal, sclerotized, caliper-shaped bands arising from lateral sclerites on anellus, narrowing and less sclerotized towards tip. Aedeagus of moderate length, slightly expanded distally, straight, base narrowly rounded; ductus ejaculatorius subbasal; vesica bulbous ventrally at distal end of aedeagus and transversely rugose; ventrally, longitudinally rugose between cornuti clusters; dorsally and ventrally covered with scale-like spines; slightly bulbous at distal end of cornuti. Cornuti (Figs 207, 208) grouped in two clusters of spines, the left cluster ventrolateral and much smaller than the dorsolateral right cluster, or sometimes completely absent. No ventral cluster of cornuti.

GENITALIA ♀ (Figs 231-238, 277-284, 317). Ovipositor lobes long, slender, dorsally fused; surface densely setose, margin with longer setae; spiny setae not easily seen (Fig. 317). Posterior apophysis with weak vertical bar and slender shaft, distally spatulate. Anterior apophysis slightly longer, thicker and curved, distally spatulate. Posterior ostial sclerite (Figs 277-284) sclerotized as a broad band, transversely wrinkled and finely denticulate, forming laterally a pair of shallow invaginations slightly intruded into the pouches of anterior sclerite, sclerite bearing faintly produced bullae meeting in mid-line. Anterior sclerite forming

laterally a pair of shallow, pouch-like invaginations, connected medially, posterior margin wrinkled and reflected. Antrum wide and long, slightly waisted, sclerotized, broadly rounded posteriorly, fitting between invaginations, heavily sclerotized laterally, forming rounded bars, anteriorly ending irregularly in widened ductus bursae. Ductus bursae funnel-shaped at base of antrum, remainder narrow, membranous and minutely spinose. Corpus bursae globular, membranous, with a pair of large, heavily sclerotized, depressed, denticulate signa.

REMARKS. This species is most closely related to *V. vitalis* and *V. tamsi*, but does not occur sympatrically with these species, which are limited to Fiji and Samoa respectively. Differential characters are discussed under *V. vitalis* and *V. tamsi* (pp. 111, 112).

Individual populations of *V. zemire* vary in external colour and pattern, but the structural differences are slight. We recognize eight subspecies, from the following geographical areas: (1) northern Moluccas; (2) southern Moluccas; (3) Misoöl, Salawati, Waigeo, New Guinea, Kepulauan Aru and D'Entrecasteaux Islands; (4) Queensland; (5) Umboi Island; (6) New Britain New Hannover and presumably New Ireland; (7) Solomon Islands; and (8) New Hebrides. More material may show that additional subspecies should be distinguished in the Moluccas and eastern Melanesia.

BIOLOGY. Early stages and host-plants unknown. Moths collected by many collectors in all months of the year.

DISTRIBUTION (Figs 5–9). Moluccas; New Guinea and its coastal islands; Kepulauan Aru; D'Entrecasteaux Islands; Queensland; Bismarck Archipelago; Solomon Islands and New Hebrides.

***Vitessa zemire expansa* subsp. n.**

(Figs 5, 62, 63, 231, 277)

♂, ♀. 48–58 mm. Generally very similar to the nominate subspecies. Fore wing above: orange basal area large, distal margin slightly protruded, straight or slightly sinuate; subbasal spot distinct. Antemedial and postmedial fasciae creamy white; antemedial fascia very narrow, diffuse medially; postmedial fascia broad, diffuse medially at base, anteriorly rounded, not reaching costa, hardly or not reaching posterior margin, terminal margin of fascia curved. Vein-lines in terminal area not reaching postmedial fascia. Hind wing below with pale apical patch tending to break into bars along veins.

GENITALIA ♂. Generally as described for species. Right lateral cornuti cluster of vesica long and narrow with well-developed spines; left lateral cornuti cluster much narrower, spines greatly reduced in size, largest posteriorly.

GENITALIA ♀ (Figs 231, 277). As described for species.

REMARKS. This subspecies is distinguished from *V. zemire zemire* by creamy white as opposed to chalky white fasciae; the antemedial fascia is slightly wider than in *V. zemire zemire*. The ♂ is known only from a single non-topotypic specimen and may therefore not be typical of the subspecies. The ♀ is like that of *V. zemire zemire* but larger and with larger orange basal area. In the ostial chamber of the genitalia (Fig. 277) the anterior margin of the posterior sclerite is broader than in *V. zemire zemire*, also the antrum is longer and broader, with a slight waist near anterior end. The subspecies is distinguished from others by the geographical range, wing markings and genital characters.

BIOLOGY. Early stages and host-plant unknown. Moths collected in May and August.

DISTRIBUTION (Fig. 5). Northern Moluccas: Halmahera and Batjan.

MATERIAL EXAMINED

Holotype ♀, **Moluccas:** Halmahera ('Halmahera'), Toeelo [Tobelo?] (*Bought from E. Le Moul't*) (BMNH).

Paratypes. **Moluccas:** 19 ♀, data as holotype (genitalia slide no.'s 14707, 14708, 15288; BMNH); 1 ♀, Halmahera (*Waterstradt*) (BMNH); 1 ♀, Halmahera, Dodinga, 1892 (*Doherty*) (BMNH).

Material excluded from paratype series. **Moluccas:** 1 ♂, 2 ♀, Batjan, v.1892, viii.1897 (*Doherty*) (BMNH); 1 ♀, Ins. Obi (*Bernst.*) (RNH, Leiden).

Vitessa zemire zemire (Stoll, [1781])
(Figs 5, 64, 65, 142, 232, 278, 317)

Phalaena zemire Stoll, [1781], in Cramer, *Papillons Exotiques*, 4 : 149, pl. 367, fig. I. Holotype ♂, MOLUCCAS: Ambon ('Amboina') (type lost; at the time of description in the collection of the Prince of Orange). [Subspecies identified from coloured figure and locality.]

Cosmethis zemire ('Cramer'); Hübner, [1820] : 179; Janse, 1924 : 503.

Vitessa zemira ('Cramer'); Lederer, 1863 : 335, pl. 6, fig. 8; Pagenstecher, 1884 : 266, 314; 1888 : 184; Ragonot, 1891 : 110. [Incorrect subsequent spellings.]

Vitessa zemire ('Cramer'); Walker, 1864 : 220; Swinhoe, 1900 : 429; Rothschild, 1915 : 223.

Vitessa zalmira ('Cramer'); Hampson, 1896b : 503. [Incorrect subsequent spelling.]

Cosmethis zemire (Stoll); de Joannis, 1930 : 637.

♂, ♀. 37–56 mm. Generally as described for species. Fore wing above: orange basal area variable, outer margin straight, curved or indented at cell and A_1 ; subbasal spot distinct, or merging with ground colour when area indented. Antemedial and postmedial fasciae chalky white; antemedial fascia very narrow, sometimes incomplete; postmedial fascia broad, slightly diffuse medially at base, anteriorly rounded, not reaching costa, hardly or not reaching posterior margin, terminal margin curved. Vein-lines in terminal area reduced or obsolete, not reaching postmedial fascia. Hind wing below with pale apical patch tending to break into bars along veins.

GENITALIA ♂ (Fig. 142). Generally as described for species, but see Remarks.

GENITALIA ♀ (Figs 232, 278, 317). Generally as described for species, but see Remarks.

REMARKS. Distinguished from *V. zemire expansa* by chalky white fasciae as opposed to creamy white fasciae. Antemedial fascia slightly narrower than in *V. zemire expansa*. The examined specimens are very variable and may include as yet unrecognized subspecies; they are generally smaller than *V. zemire expansa*. The only known ♂ is in poor external condition and has genitalia identical with those of *V. zemire expansa*, also known from only one ♂; in both specimens the genitalia are somewhat damaged. In the ♀ genitalia the anterior margin of the posterior ostial sclerite (Fig. 278) is narrower than in *V. zemire expansa*, also the antrum is shorter and narrower, with a slight waist in the mid region. The subspecies is distinguished from others by the geographical range, wing markings and genital characters.

BIOLOGY. Early stages and host-plant unknown. Moths collected in January and February.

DISTRIBUTION (Fig. 5). Southern Moluccas: Seram, Ambon and Saparua.

MATERIAL EXAMINED

Moluccas: 1 ♀, Seram (*ex Felder coll.*) (BMNH); 1 ♀, Central Seram, Mansela [sic] [3°15' S, 129°38' E], 650 m, 1912 (*Stresemann*) (BMNH); 1 ♀, Seram, Wahaai (*Moens*) (RNH, Leiden); 1 ♀, Ambon (*ex Musaeo* Dr. Boisduval) (BMNH); 1 ♀, Ambon (*Doleschal*) (BMNH); 4 ♀, Ambon, ii.1892 (*Doherty*) (BMNH); 1 ♀, Ambon (*Wallace*) (UM, Oxford); 1 ♀, Saparua, Oeliasers, i.1892 (*exp. Martin*) (BMNH); 1 ♂, Saparua (*Fruhstorfer*) (BMNH); 1 ♀, no data (*ex Felder coll.*) (BMNH).

Vitessa zemire temerata Swinhoe, 1906 stat. n.
(Figs 6, 66, 67, 143, 177, 233, 279)

Vitessa zemira ('Cramer'); Pagenstecher, 1886 : 167, 188. [Partim; incorrect subsequent spelling.]

Vitessa temerata Swinhoe, 1906, *Ann. Mag. nat. Hist.* (7) 18 : 413. LECTOTYPE ♂, NEW GUINEA: Papua, Granville ['Port Moresby'] 1907–128 (genitalia slide no. 15289; BMNH), here designated [examined].

Vitessa zemira ('Cramer'); Kenrick, 1907 : 75. [Incorrect subsequent spelling.]

Cosmethis temerata (Swinhoe); Janse, 1928 : 88.

♂, ♀. 38–62 mm. Generally as described for species. Fore wing above with orange basal area slightly variable, large, distal margin straight or curved; subbasal spot distinct. Antemedial and postmedial fasciae creamy white; antemedial fascia as wide as or wider than glossy blue-black subbasal fascia, medially diffuse; postmedial fascia very wide, width more than half length of fascia, slightly diffuse medially, distal margin sinuate, fascia truncate, short of costa but reaching posterior margin. Vein-lines in terminal area not reaching postmedial fascia. Hind wing below with pale apical patch tending to break into bars along veins but solid till past M_1 .

GENITALIA ♂ (Figs 143, 177). Generally as described for species, but see Remarks.

GENITALIA ♀ (Figs 233, 279). Generally as described for species, but see Remarks.

REMARKS. This is distinguished from all other subspecies of *V. zemire* by the very broad, sharply defined postmedial fascia and fairly wide antemedial fascia, being closest in appearance to *V. zemire expansa* and *V. zemire zemire*; the subspecies *nephritica* from Queensland has equally broad fasciae but is distinguished by the diffusion of both into the medial region. In the ♂ genitalia the cornuti clusters are larger than in previous subspecies, the left cluster has much reduced, almost obsolete spines for most of posterior length. The ♀ genitalia are almost identical to those of previous subspecies, but most closely resemble those of *V. zemire expansa* in the shape of the antrum (Fig. 279), though in the present subspecies the antrum is shorter.

BIOLOGY. Early stages and host-plant unknown. Moths collected by many collectors in all months of the year.

DISTRIBUTION (Fig. 6). Misoöl; Salawati; Waigeo; New Guinea; Kepulauan Aru; D'Entrecasteaux Islands.

MATERIAL EXAMINED

Paralectotypes. **New Guinea:** 1 ♂, 2 ♀, labelled 6846, otherwise data as lectotype (genitalia slide no. 15290; BMNH); 11 ♂, 14 ♀, Mount Kebea, 1100 m ('3600 ft'), vi–viii.1903 (*A. E. Pratt*) (BMNH).

Misoöl: 5 ♂, Mysol, foot-hills, 30–150 m, wet season, x–xi.1916 (*Frost*) (BMNH); 1 ♀, central Mysol, bush country, about 60 m, wet season, x.1916 (*Frost*) (BMNH); 1 ♀, Misol, i.1899 (*Kühn*) (BMNH). **Salawati:** 1 ♂, (*Bernst*) (RNH, Leiden); 1 ♂, Salvati [Salawati?], 1875 (*Bruijn*) (BMNH). **Waigeo:** 1 ♂, 2 ♀, Waigeu (*Waterstradt*) (BMNH); 1 ♂, Waigeoe, 1875 (*Bruijn*) (BMNH); 2 ♂, 5 ♀, Waigeu, Camp Nok, 750 m, v.1938 (*Cheesman*) (BMNH). **New Guinea:** 2 ♀, Irian Jaya, Mamberamo, Pionierbivak, vii.1920 (*Heurn*) (RNH, Leiden); 4 ♂, I. J., Sorong, 1875 (*Bruijn*) (BMNH); 2 ♀, I. J., Dorey Bay, Andai (*Doherty*) (BMNH); 5 ♀, I. J., Arfak Mts, 1200 m, ii–iii.1909 (*C. B. Pratt*) (CMAG, Birmingham); 4 ♀, I. J., central Arfak Mts, Ninay Valley, 1050 m, xi.1908–i.1909 (*Pratt*) (BMNH); 1 ♀, I. J., Arfak Peninsula, Momi Coast (= Wariab), ii.1928 (*Mayr*) (BMNH); 2 ♂, 6 ♀, I. J., Kapaur, low country, xii.1896–i.1897 (*Doherty*) (BMNH); 1 ♀, I. J., Kapaur (*Doherty*) (MM, Manchester); 1 ♀, I. J., River Tor (mouth), 4 km E. of Hol[andia], Maffen, vii.1959 (*Maa*) (BPBM, Honolulu); 1 ♂, I. J., Wandammen Mts, 900–1200 m, xi.1914 (*A. C. & F. Pratt*) (TM, Pretoria); 1 ♀, I. J., Geelvink B[a]y, Nomnagihé, 600 m, i–ii.1921 (*Pratt*) (TM, Pretoria); 2 ♂, 2 ♀, I. J., Nomnagihé, 15–33 km south of Wangaar, 600 m, i–ii.1921 (*C. F. & J. Pratt*) (TM, Pretoria); 1 ♀, I. J., Etna Bay, viii.1896 [3°58' S, 134°47' E] (*Kühn*) (BMNH); 4 ♂, 4 ♀, I. J., Snow Mts, nr Oetakwa R., 1050 m, x–xii.1910 (*Meek*) (BMNH); 1 ♀, I. J., Utakwa ['Oetakwa'] R., 750–900 m, ii.1913 (*Wollaston*) (BMNH); 1 ♂, 3 ♀, I. J., Snow Mts, Upper Setakwa R., 600–900 m, viii–ix.1910 (*Meek*) (BMNH); 1 ♀, I. J., Mt Goliath, 1500 m, about 139° Long. [4°40' S, 139°52' E], iii.1911 (*Meek*) (BMNH); 1 ♂, 1 ♀, I. J., Cyclops Mts, Sabron, Camp 2, 600 m, vii.1936 (*Cheesman*) (BMNH); 1 ♀, I. J., Humboldt Bay, ix–x.1892 (*Doherty*) (BMNH); 1 ♂, I. J., Humboldt Bay Dist., Uskwar, v.1937 (*Stüber*) (BMNH); 1 ♂, Papua New Guinea, Humboldt Bay Dist., Wembi, vii.1937 (*Stüber*) (BMNH); 1 ♀, P. N. G., Njau-limon, vi. 1937 (*Stüber*) (BMNH); 1 ♀, P. N. G., Torricelli Mts, Sea Falls between Afua & Chinapelli villages, iv.1939 (*Moore*) (BMNH); 2 ♀, P. N. G., Torricelli Mts, Mokai, 800 m, xii.1958 (*Brandt*) (ANIC, Canberra); 1 ♂, 1 ♀, P. N. G., Sepik Dist., Bainyik, 300 m, x.1957 (*Munroe & Holland*) (CNC, Ottawa); 1 ♀, P. N. G., Sepik Dist., Angoram, 6 m, 1959 (*Brandt & Hallstrom*) (ANIC, Canberra); 1 ♀, P. N. G., Telefomin, 1350–1700 m, vi–ix.1959 (*Brandt*) (ANIC, Canberra); 8 ♀, P. N. G., Astrolabe Bay, iii–x (*Wahnes*) (BMNH); 1 ♀, P. N. G., Finisterre Range, Kiambavi, 1350 m, vi–vii.1958 (*Brandt*) (ANIC, Canberra); 1 ♀, P. N. G., Finisterre Mts, Wantoat, 1200 m, ix.1957 (*Munroe & Holland*) (CNC, Ottawa); 3 ♂, 4 ♀, P. N. G., Mount Kebea, 1100 m, vi–viii.1903 (*A. E. Pratt*) (BMNH; CMAG, Birmingham); 2 ♀, P. N. G., Aroa R., Booboomie, 600 m, v.1905 (*Meek*) (BMNH); 6 ♀, P. N. G., Aroa R. (*Meek*) (BMNH); 3 ♂, 3 ♀, P. N. G., Lower Aroa R., xi.1904–iii.1905 (*Meek*) (BMNH); 2 ♀, P. N. G., Upper Aroa R., iii.1903 (*Meek*) (BMNH); 7 ♂, 7 ♀, P. N. G., Babooni, 900–1100 m, vii–ix.1903 (*A. E. Pratt*) (BMNH; CMAG, Birmingham); 1 ♀, P. N. G., Ekeikei, 450 m, iii–iv.1903 (*Pratt*) (BMNH); 2 ♂, 1 ♀, P. N. G., Foula, 1350 m, viii.1903 (*Pratt*) (BMNH); 1 ♀, P. N. G., St Joseph R. [8°56' S, 147°20' E] (*Weiske*) (BMNH); 1 ♀, P. N. G., Brown R. (*Weiske*) (BMNH); 4 ♂, 6 ♀, P. N. G., Sogeri Plateau, Bisianumu, 500 m, viii.1957 (*Munroe & Holland*) (CNC, Ottawa); 5 ♂, 11 ♀, P. N. G., Sogeri Plateau, Mageri, 500 m, viii.1957 (*Munroe & Holland*) (CNC, Ottawa); 1 ♀, P. N. G., Central Dist., Subitana, 550 m, i.1949 (*Brandt & Hallstrom*) (ANIC, Canberra); 2 ♂, 2 ♀, P. N. G., Mambare R., Biagi, 1500 m, i–iii.1906 (*Meek*) (BMNH); 3 ♂, 6 ♀, P. N. G., Hydrographer Mts, 750 m, i–iii.1918 (*Eichhorn*

Bros.) (BMNH); 1 ♀, P. N. G., Collingwood Bay, Haidana (*Meek*) (BMNH); 2 ♂, 2 ♀, P. N. G., Amazon Bay area, Doveta, 750 m, vii–ix.1962 (*Brandt*) (ANIC, Canberra); 1 ♂, 13 ♀, P. N. G., Milne Bay, xii.1898–ii.1899 (*Meek*) (BMNH; NMNH, Washington); 2 ♀, P. N. G., Sariba I. (*Meek*) (BMNH); 1 ♀, no data (*Barnett*) (BMNH); 1 ♀, no data (*Joicey coll.*) (BMNH); 2 ♀, no data (*Rosenberg*) (RSM, Edinburgh); 2 ♀, no data (*Walsh*) (RNH, Leiden); 2 ♀, no data (BMNH); 1 ♀, no data (UM, Oxford). **Kepulauan Aru:** 1 ♂, Aroe [Aru] (*Kühn*) (BMNH); 1 ♂, Ureiuning (BMNH); 1 ♀, Dobbo (Dobo), 1897 (*Doherty*) (BMNH). **D'Entrecasteaux Islands:** 3 ♀, Fergusson I., xii.1894–xii.1895 (*Meek*) (BMNH).

Vitessa zemire nephritica subsp. n.

(Figs 6, 26, 68, 69, 144, 178, 234, 280)

♂, ♀. 43–56 mm. Generally as described for species. Fore wing above with orange basal area large, outer margin finely protruded at costa, mid-line and posterior margin; subbasal spot distinct. Antemedial and postmedial fasciae pale jade green; antemedial fascia broad, diffuse medially and at points meeting diffusion from very broad postmedial fascia; postmedial fascia finely separated from costa but reaching posterior margin, terminal margin sinuate. Vein-lines in terminal area strongly developed and at some points faintly joining postmedial fascia. Hind wing below with pale apical patch tending to break into bars along veins, but solid till past M_1 , faintly extended down to Cu_2 .

GENITALIA ♂ (Figs 26, 144, 178). Generally as described for species, but see Remarks.

GENITALIA ♀ (Figs 234, 280). Generally as described for species, but see Remarks.

REMARKS. This is distinguished from all other subspecies of *V. zemire* by the very broad fasciae, which diffuse medially and join in places. The jade green coloration is striking in fresh material, but is faded in old specimens. In the ♂ genitalia the right cornuti cluster is slightly shorter than in *V. zemire temerata*, the left cornuti cluster is greatly reduced in length, its anterior spines being nearly obsolete, mostly represented only by sclerotized bases. The ♀ genitalia have the antrum (Fig. 280) slightly narrower than in *V. zemire temerata*, its sides more nearly parallel but the lateral areas much less heavily sclerotized, and the anterior waist hardly accentuated. The signa are smaller than in all previous subspecies.

BIOLOGY. Early stages and host-plant unknown. Moths collected from March to May.

DISTRIBUTION (Fig. 6). Australia: Queensland.

MATERIAL EXAMINED

Holotype ♂, **Australia:** Queensland, Mt Edith, 18 mls [29 km] north-east of Atherton, 3400 ft [1050 m], 18.iii.1964 (*Common & Upton*) (ANIC, Canberra).

Paratypes. **Australia:** 1 ♀ (allotype), Queensland, 27 km ('17 mls') south of Atherton, 900 m ('3000 ft'), 19.iii.1964 (*Common & Upton*) (ANIC, Canberra); 5 ♂, 2 ♀, Q., 18 km ('11 mls') south of Ravenshoe, 800 m ('2700 ft'), iii.1964 (*Common & Upton*) (ANIC, Canberra; CNC, Ottawa); 1 ♂, Q., Mt Bartle Frere, East Base [17°27' S, 145°53' E], 24 m ('80 ft'), iii.1955 (*Common*) (ANIC, Canberra); 1 ♀, Q., L. Barrine [17°16' S, 145°38' E], v.1939 (ANIC, Canberra); 5 ♂, 8 ♀, Q., Atherton Tableland, Millaa Millaa, 750 m ('2500 ft'), iv.1932 (*Darlington*) (Genitalia slide no.'s DK 69, DK 70; MCZ, Cambridge, Mass.; CNC, Ottawa); 1 ♂, 2 ♀, Q., Kuranda, n. Cairns, 1910 (*Dodd*) (Genitalia slide no.'s 15291, 15292; BMNH); 1 ♀, same locality, 26.v.[19]02 (*F.T.*) (ANIC, Canberra); 1 ♀, Q., Atherton (ANIC, Canberra); 1 ♂, Q., 5 km ('3 mls') west of Mossman, 4.iii.[19]64 (*Common & Upton*) (ANIC, Canberra); 1 ♂, Q., Palmerston National Park, on Tully-Cairns Power Line, at light, in rain forest, 6.xi.1966 (*Britton*) (ANIC, Canberra); 1 ♀, Q., 14 km ('9 mls') west of Kennedy, 610 m ('2000 ft'), 17.iv.1969 (*Common & Upton*) (ANIC, Canberra); 1 ♂, no data (MNH, Paris).

Vitessa zemire coronis subsp. n.

(Figs 7, 70, 71, 145, 179, 207, 235, 281)

♂, ♀. 44–58 mm. Generally as described for species. Fore wing above with orange basal area large, outer margin straight, slightly produced distad in ♂ at posterior margin, in ♀ broadly produced at base of cell; subbasal spot distinct. Antemedial and postmedial fasciae narrow, variable; antemedial fascia narrower than postmedial, greenish white, slightly diffuse medially; postmedial fascia creamy white, generally widest in mid region, anteriorly rounded, not reaching costa, posteriorly with slight diffusion medially, not

reaching posterior margin, outer margin in ♂ rounded, in ♀ broadly indented between M_1 and M_2 . Vein-lines in terminal area of ♂ extending back to Cu_1 , well separated from postmedial fascia; in ♀ far less strongly developed. Hind wing below with pale apical patch tending to break into bars along veins.

GENITALIA ♂ (Figs 145, 179, 207). Generally as described for species, but see Remarks.

GENITALIA ♀ (Figs 235, 281). Generally as described for species, but see Remarks.

REMARKS. This is distinguished from previous subspecies by the much narrower white fasciae; from *V. zemire novaebritanniae* by the generally broader white fasciae and a more distinct subbasal spot in the orange basal area; from remaining subspecies by not having the orange basal area indented, by having white apical markings on the underside of the hind wing and lacking the white spot over the cell. In the ♂ genitalia the right cornuti cluster (Fig. 207) is relatively longer than in previous subspecies, the left cornuti cluster is just as long, but has the spines developed only on the posterior half; on the anterior half they are reduced to sclerotized bases. In the ♀ genitalia the antrum (Fig. 281) is longer than in *V. zemire nephritica* and laterally more heavily sclerotized; it is broadest at posterior end, with a slight waist anteriorly. The corpus bursae has the signa larger than in *V. zemire nephritica*.

BIOLOGY. Early stages and host-plant unknown. Moths collected in July and August.

DISTRIBUTION (Fig. 7). Bismarck Archipelago: Umboi Island.

MATERIAL EXAMINED

Holotype ♂, **Bismarck Archipelago**: Rook[e] Island, viii.1913 (*Meek*) (BMNH).

Paratypes. **Bismarck Archipelago**: 3 ♂, 2 ♀ (including allotype), vii–viii, data as holotype (genitalia slide no.'s 14716, 15137, 15293, 15294; BMNH).

Vitessa zemire novaebritanniae subsp. n.

(Figs 7, 72, 73, 146, 180, 236, 282)

♂, ♀. 40–54 mm. Generally as described for species. Fore wing above with orange basal area large, outer margin straight or variably sinuate; subbasal spot much reduced. Antemedial and postmedial fasciae very narrow, greenish white; antemedial fascia reduced to sometimes incomplete hair-line; postmedial fascia not reaching costa or posterior margin, posteriorly with slight diffusion medially, outer margin in both sexes broadly indented between M_1 and M_2 . Vein-lines in terminal area of ♂ reaching down to M_3 , well separated from postmedial fascia; far less developed in ♀. Hind wing below with pale apical markings breaking into bars along veins at least to R_5 , sometimes as far as M_3 .

GENITALIA ♂ (Figs 146, 180). Generally as described for species, but see Remarks.

GENITALIA ♀ (Figs 236, 282). Generally as described for species, but see Remarks.

REMARKS. This is distinguished from all other subspecies by the much narrower white fasciae. Among the subspecies having large, non-indented, orange basal areas, this subspecies shows greatest reduction in the size of the subbasal spot. Among the subspecies with white apical markings on the underside of the hind wing, these are the most reduced in this subspecies. Specimens from New Hannover tend to have the antemedial fascia and the subapical vein-streaks better developed, but are not always distinguishable. In the ♂ genitalia the right cornuti cluster is slightly smaller than in *V. zemire coronis*, the left cornuti cluster is shorter than the right, with short spines present on posterior quarter of cluster, the remainder reduced to sclerotized bases. In the ♀ genitalia the antrum (Fig. 282) is similar to that of *V. zemire coronis* but narrower posteriorly; the corpus bursae and signa are of the same size as in that subspecies.

BIOLOGY. Early stages and host-plant unknown. Moths collected from January to March.

DISTRIBUTION (Fig. 7). Bismarck Archipelago: New Britain; New Hannover; New Ireland.

MATERIAL EXAMINED

Holotype ♂, **Bismarck Archipelago**: New Britain, Talesea, i.1925 (*A. F. Eichhorn*) (genitalia slide no. 14632; BMNH).

Paratypes. **Bismarck Archipelago**: 3 ♂, 2 ♀ (including allotype), data as holotype (genitalia slide no.'s 14634, 15134, 15295, 15296; BMNH).

Material excluded from paratype series. **Bismarck Archipelago:** 10 ♂, 2 ♀, New Hannover, ii-iii.1923 (*Meek*) (BMNH; TM, Pretoria); 1 ♂, New Ireland, Schleinitz Mountains, 915 m ('3000 ft'), 2.x.-15.xii.1959 (*Brandt*) (ANIC, Canberra).

***Vitessa zemire solomonis* subsp. n.**

(Figs 8, 74, 75, 147, 181, 237, 283)

♂, ♀. 46–58 mm. Generally as described for species. Fore wing above with orange basal area reduced, split at A_1 by V-shaped indentation from outer margin; subbasal spot large, sometimes joining costa. Antemedial and postmedial fasciae very narrow, creamy white; antemedial fascia narrow in ♂, slightly short of costa and posterior margin, in ♀ reduced to hair-line; postmedial fascia well short of costa and posterior margin, slightly diffuse medially, outer margin in both sexes slightly rounded. Vein-lines in terminal area in ♂ from between R_4 to Cu_1 , in ♀ variable, from just a trace between R_4 and R_5 to lines reaching between Cu_2 and CuP ; mostly separated from postmedial fascia. Hind wing below with pale apical marking reduced to faintest trace, but with white streak along costa from apex to about level with medial side of postmedial fascia of fore wing; small, triangular, oblique, white spot at apex of cell, commencing at and following lines of discocellular vein.

GENITALIA ♂ (Figs 147, 181). Generally as described for species. Left cornuti cluster absent; right cornuti cluster short, crescent-shaped, spines longest at centre. See Remarks.

GENITALIA ♀ (Figs 237, 283). Generally as described for species. Antrum laterally asymmetrical, right lateral margin concave, left lateral margin convex. See Remarks.

REMARKS. This is distinguished from previous subspecies by having a white spot at the apex of cell on the underside of the hind wing; by lacking a definite apical marking but having a short white streak on the costa. On the upperside of the fore wing the deeply indented orange basal area is shared only by *V. zemire zemire*, from which the present subspecies is distinguished by the narrower postmedial fascia. *V. zemire solomonis* is distinguished from *V. zemire cheesmanae* by the slightly narrower postmedial fascia and by the predominant tendency for the terminal vein-lines on the upperside of the fore wing not to reach the postmedial fascia, the only exception seen being a ♀ from Guadalcanal Island. The ♂ genitalia are easily distinguished from those of the previous subspecies by the absence of the left cornuti cluster; the ♀ genitalia by the asymmetry of the antrum (Fig. 283), though this asymmetry is less accentuated than in *V. zemire cheesmanae*.

BIOLOGY. Early stages and host-plant unknown. Moths collected in January, February, April, June, November and December.

DISTRIBUTION (Fig. 8). Solomon Islands: Bougainville Island to Guadalcanal Island.

MATERIAL EXAMINED

Holotype ♂, **Solomon Islands:** Florida I., i.1901 (*Meek*) (genitalia slide no. 15297; BMNH).

Paratypes. **Solomon Islands:** 2 ♀, Bougainville, iv.1904 (*Meek*) (BMNH); 1 ♀, north side of Choiseul I., xii.1903 (*Meek*) (BMNH); 3 ♀, Guizo I., xi.1903 (*Meek*) (genitalia slide no. 15135; BMNH); 1 ♀, Rendova, ii.1904 (*Meek*) (BMNH); 6 ♀ (including allotype), data as holotype (BMNH); 1 ♀, Tugela (*Woodford*) (genitalia slide no. 15298; BMNH); 1 ♀, Guadalcanal, Honiara, vi.1971 (*H. S. Robinson*) (BMNH).

***Vitessa zemire cheesmanae* subsp. n.**

(Figs 9, 76, 77, 148, 182, 208, 238, 284)

♂, ♀. 48–52 mm. Generally as described for species and for *V. zemire solomonis*. Fore wing above with considerable green in the blue reflections of the dark ground colour. Orange basal area deeply indented, subbasal spot always separated from costa. White antemedial fascia narrow but complete, slightly diffuse medially. Postmedial fascia broad, not reaching costa or posterior margin, medially extended and slightly diffuse, terminal margin broadly rounded and sinuate. Vein-lines in terminal area extending back to Cu_2 , separated from but close to postmedial fascia. Hind wing below with white costal streak and white marking on discocellular vein.

GENITALIA ♂ (Figs 148, 182, 208). Generally as described for species. Left cornuti cluster greatly reduced to minute group of short spines and sclerotized spine-bases. Right cornuti cluster short, crescent-shaped, spines longest at centre. See Remarks.

GENITALIA ♀ (Figs 238, 284). Generally as described for species. Antrum (Fig. 284) laterally asymmetrical. See Remarks.

REMARKS. This is distinguished from *V. zemire solomonis* by the broader postmedial fascia and by the terminal white lines being closer to the postmedial fascia. It differs from all other subspecies of *V. zemire* by the presence of a white discocellular marking on the underside of the hind wing. In the ♂ genitalia this subspecies differs from *V. zemire solomonis* in the presence of a small left cornuti cluster (Fig. 208) consisting of sclerotized bases. The ♀ genitalia are distinguished by the more strongly asymmetrical, narrower and longer antrum (Fig. 284) and by the larger signa. This subspecies and *V. zemire solomonis* are somewhat atypical of the species, but the general similarity to other subspecies is so great that separate specific status is unwarranted. We take pleasure in dedicating this subspecies to Miss L. E. Cheesman, collector of the holotype, in recognition of her extensive contribution to the knowledge of Pacific entomology.

BIOLOGY. Early stages and host-plant unknown. Moths collected from March to May and in August. A specimen from Efate recorded as flying at 1600 h.

DISTRIBUTION (Fig. 9). New Hebrides.

MATERIAL EXAMINED

Holotype ♂, **New Hebrides**: Malekula, Ounua [Bay, 16°14' S, 167°36' E, nr Bansarik], iv–v.1929 (*Cheesman*) (genitalia slide no. 14630; BMNH).

Paratypes. **New Hebrides**: 1 ♀ (allotype), data as holotype (genitalia slide no. 14631; BMNH); 1 ♀, Efate, near Vila, Montmartre, flying 1600 h, 9.iii.1974 (*Maddison*) (genitalia slide no. 15299; BMNH); 6 ♂, 14 ♀, Espiritu Santo, south coast, Narango, v–vii.1960 (*Brandt*) (ANIC, Canberra; CNC, Ottawa); 2 ♂, Espiritu Santo I. (SW), above Namatasopa [15°31' S, 166°49' E] 400 m, viii.1957 (*Gressitt*) (BPBM, Honolulu); 1 ♂, [no exact locality] (*HMS Dart*) (BMNH).

Vitessa vitalis Hampson, 1906

(Figs 10, 78–80, 149, 183, 209, 239, 285)

Vitessa vitalis Hampson, 1906, *Ann. Mag. nat. Hist.* (7) 17 : 217. Holotype ♀, FIJI (*Crowley Bequest*) (genitalia slide no. 15300; BMNH) [examined].

♂, ♀. 54–60 mm. Frons smoothly scaled, glossy blue-black. Vertex with erect bushy orange scaling, extending forward between antennae. Eye and ocellus black. Chaetosema with orange setae. Antenna with pectinations in ♂ very short, black; dorsal scaling of antennal shaft glossy black, except basal half of apical third white. Labial palpus with first and second segments orange, third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis blue-black with violaceous reflections. Neck region orange. Thorax above: orange, with narrow, medial, longitudinal blue-black stripe; patagium glossy blue-black; tegula orange with anterolateral blue-black spot. Abdomen above: matt black, a narrow white terminal line on each segment, except last segment with posterior margin orange, anal tuft orange. Body below: glossy blue-black; pectus orange; white terminal lines on abdominal segments broader than above, last segment with posterior margin orange, anal tuft orange. Legs in ♂ with most parts of coxae, femora and tibiae covered with bushy orange scales, remaining parts dark fuscous; legs in ♀, glossy green-black, ventral surfaces of mid and hind femora white, tibiae white-tipped. Fore wing above: base blue-black with strong gloss; subbasal area orange, reaching *Cu*, short of costa, finely edged with weakly glossy blue-black; subbasal fascia blue-black with strong gloss; yellowish white antemedial fascia erect narrow, short of costa and posterior margin, finely diffuse medially; medial fascia blue-black; yellowish white postmedial fascia slightly oblique, pointing towards posterior margin well basad of tornus, narrow, widest at centre, medial and terminal margins irregular; terminal area blue-black, yellowish white vein-lines short of postmedial fascia; dark areas of wing with strong greenish hue; fringe basally dark grey, distally white, flecked with dark grey. Hind wing above blue-black with weak violaceous reflections, cubital and anal area covered with long black hairs; fringe basally dark grey, distally white flecked with dark grey. Fore wing below: blue-black, in ♂ with strong diffusion of orange at base, finely diffuse on costa and posterior margin; dark areas with violaceous reflections, weak greenish hue especially at costa; retinaculum dark grey; yellowish white postmedial fascia as above but more diffuse; vein-lines short, apical; fringe as above. Hind wing below as above, apical vein-lines fine; in ♂ basal and discal areas with orange suffusion, strongest on veins, especially discocellular vein; ♀ without orange suffusion but with minute patch of white scales on angle of discocellular.

GENITALIA ♂ (Figs 149, 183, 209). Uncus wide, depressed, concave ventrally like an inverted trough, decurved then upcurved to tip, bearing lateral setae for most of its length. Gnathos arms broadening medially, flattened medial process deep at base, acutely sickle-shaped, tip finely acuminate. Transtilla shallowly V-shaped, medially narrow. Tegumen with medially broadened narrow posterior sclerite; anterior sclerite medially upturned, with broad keyhole-shaped emargination. Vinculum wide, laterally broadened, base strongly concave. Valve long, very narrow, costa inflated at base, apex narrowly rounded; with narrow, central, longitudinal sclerotized band; mesal surface with long oblique striations; posterior margin heavily sclerotized, especially at broadened base; long curved club-shaped clasper at midlength of posterior margin, on widened oblique base, extending posteriorly at right angles then curving basad. Juxta wide; lateral sclerites broad, heavily sclerotized, each bearing short wide dorsal and ventral processes, posteromedially directed; anellus (Fig. 183) supported by dorsal juxta process, with large, lateral, antero-medially directed sclerites, bearing large anteriorly directed spines; manica supported by sclerotized bands continuous with lateral sclerites. Aedeagus long, distally widened, base narrowly rounded, ductus ejaculatorius subbasal; spines of vesica mainly basal, vesica ventrally bulbous at distal end of aedeagus and transversely rugose, vesica with ventrolateral left and dorsolateral right cornuti clusters (Fig. 209), longitudinally rugose dorsally between cornuti clusters; right cluster longer than left, with longer spines.

GENITALIA ♀ (Figs 239, 285). Ovipositor lobes dorsally fused, dorsally narrowly produced, densely setose, setae longer on margins; spiny setae not easily seen. Posterior apophysis long, straight, distally widening, spatulate at tip. Anterior apophysis longer, thicker, sinuate, with inwardly curved spatulate tip. Posterior ostial sclerite (Fig. 285) broad, heavily sclerotized, posterior margin with small V-shaped medial incision; small anteromedial bullae; sulcus wide, margins separated. Anterior margin of ostium mostly membranous, inner part weakly sclerotized, wrinkled, laterally minutely denticulate. Antrum short, weakly sclerotized, except for a small anteromedial sclerotized area. Ductus bursae irregularly swollen posteriorly; narrow anterior part minutely spined. Corpus bursae large, oval, membranous, with small, paired, heavily sclerotized, depressed, denticulate signa.

REMARKS. This species bears considerable resemblance to *V. zemire*, but otherwise it can be confused only with *V. tamsi* from Samoa. It differs from *V. zemire* in the markings of the fore wing; the orange area is subbasal, the white fasciae are distinctly yellowish, the very wide terminal area has almost equally long pale lines on most veins. The ♂ is unlike other species except *V. tamsi*, in the presence of massive orange scaling (androconia ?) on the femora and tibiae and unlike other species, including *V. tamsi*, with sex-limited orange scaling on the underside of the hind wing. The ♂ genitalia are unlike those of any other species except *V. tamsi*, which shares the wide, flattened uncus, the long narrow valve and the club-shaped clasper. In *V. vitalis* the transtilla is V-shaped, the clasper lacks a ridge from base, the juxta is narrower and the left cornuti cluster is larger than in *V. tamsi*. The ♀ genitalia are distinctive in the shape of the swollen posterior end of ductus bursae and in the much reduced antrum, but those of *V. tamsi* are almost identical (see Remarks under that species). There is some individual variation in external and genital characters. The two specimens from the Lau group, though worn, appear to have the postmedial fascia of the fore wing wider, but whether this is a significant difference remains to be seen. This is the only known species in the Fiji Islands.

BIOLOGY. Early stages and host-plant unknown. Moths collected in January, from June to October and in December.

DISTRIBUTION (Fig. 10). Fiji: Vanua Levu, Viti Levu and Lau Group.

MATERIAL EXAMINED

Fiji: 6 ♀, Vanua Levu, Navonu, Forest Area Niuvundi, ix.1975 (*Maddison*) (BMNH; KRS, Fiji); 1 ♀, Viti Levu, Vuni[n]dawa, vii.1932, caught in butter dish at tea (*Phillips*) (BMNH); 1 ♀, V. L., Nandarivatu, x.1937 (*Valentine*) (BPBM, Honolulu); 1 ♀, V. L., Nandarivatu, 800 m, ix.1955 (*Simmonds*) (BMNH); 1 ♀, V. L., Nandarivatu, vi.1968 (*H. S. Robinson*) (BMNH); 1 ♂, 1 ♀, V. L., Nandarivatu, ix.1974 (*G. S. Robinson*) (BMNH); 2 ♀, V. L., Savura Creek, 1966–67, i.1967 (*H. S. Robinson*) (BMNH); 1 ♀, V. L., Savura Creek, vii.1969 (*H. S. & G. S. Robinson*) (BMNH); 1 ♂, 1 ♀, V. L., Tholoisuva, xii.1958 (*Simmonds*) (BMNH); 1 ♀, V. L., Colo-i-suva, Malaise trap, iii.1963 (*Yoshimoto*) (BPBM, Honolulu); 1 ♀, V. L., Coloi Suva [Tholoisuva], viii.1968 (*H. S. & G. S. Robinson*) (BMNH); 1 ♀, V. L., Suva, vii.1954 (*Simmonds*) (BMNH); 1 ♂, Lau Group, Namuka [-i-Lau], xii.1924 (*Bryan*) (BPBM, Honolulu); 1 ♀, Ongea, viii.1924 (*Bryan*) (BPBM, Honolulu).

Vitessa tamsi sp. n.

(Figs 11, 42, 43, 81, 240, 286)

♂, ♀. 52–58 mm. In general as described for *V. vitalis*. Tegula orange with anterior blue-black spot. Thorax above: orange with wide, medial, longitudinal blue-black stripe. Fore wing above with yellowish white postmedial fascia, in ♀ half as wide as long, wider in ♂, medially rounded, not reaching costa or posterior margin, very oblique, pointing towards tornus; orange subbasal area narrow. Fore wing below: postmedial fascia as wide as above; antemedial fascia faintly indicated. Hind wing below: white spot on discocellular vein varying from a few scales to a spot over half width of cell. Wings of ♂ below like those of ♀, without orange scaling, and with white discocellular marking.



Fig. 42 *Vitessa tamsi* sp. n., ♂ allotype, Western Samoa.

GENITALIA ♂ (Fig. 43). In general as described for *V. vitalis*. Transtilla nearly straight. Genitalia damaged, valve tips missing. Club-shaped clasper with short, straight, raised ridge extending from base towards base of valve. Anterior portion of juxta very broad. Aedeagus with slightly reduced left cornuti cluster.

GENITALIA ♀ (Figs 240, 286). In general as described for *V. vitalis*. Posterior apophysis short, slightly sinuate, distally widening and spatulate at tip. Anterior apophysis short, thicker, straight, distally tapering, tip spatulate. Posterior ostial sclerite (Fig. 286) narrow, strongly sclerotized, posterior margin with small V-shaped medial incision; anterior margin broadly upturned medially, small anteromedial bullae, wide sulcus between, margins separated; sclerite slightly bulging laterally. Antrum sclerotization very weak, hardly visible.

REMARKS. This species is very closely related to *V. vitalis*, of which it is the Samoan vicariant. It is distinguished externally by the broader and more oblique postmedial fascia on the upperside of the fore wing pointing to the tornus, not to the posterior margin basad of the tornus as in *V. vitalis*, and by the slightly narrower orange subbasal area. The postmedial fascia is noticeably wider in the ♂ than in the ♀. The tegula bears an anterior blue-black spot rather than an antero-lateral spot as in *V. vitalis*. *V. tamsi* shares with *V. vitalis* the strong greenish hue over all dark areas on wings and legs. In the ♂ the underside of the wings lacks the extensive diffusion of orange scaling seen in the ♂ of *V. vitalis*. The ♂ genitalia differ from those of *V. vitalis* by the straighter transtilla, the short raised ridge extending from the base of the clasper, by the broader anterior portion of the juxta, and by the smaller left cornuti cluster of the vesica.

In the ♀ genitalia the posterior ostial sclerite is much narrower medially in *V. tamsi*, almost making two triangular areas. The antrum is hardly sclerotized, whereas in *V. vitalis* a small triangular sclerotized plate is present. The ductus bursae is longer than the bursa in *V. tamsi*, shorter in *V. vitalis*. These differences seem of specific rather than subspecific value. We take pleasure in dedicating this species to our esteemed colleague Mr W. H. T. Tams, in recognition of his contributions to the knowledge of the moths of Samoa.

BIOLOGY. Early stages and host-plant unknown. Moths collected in January, March and September.

DISTRIBUTION (Fig. 11). Western Samoa; so far known only from Upolu.

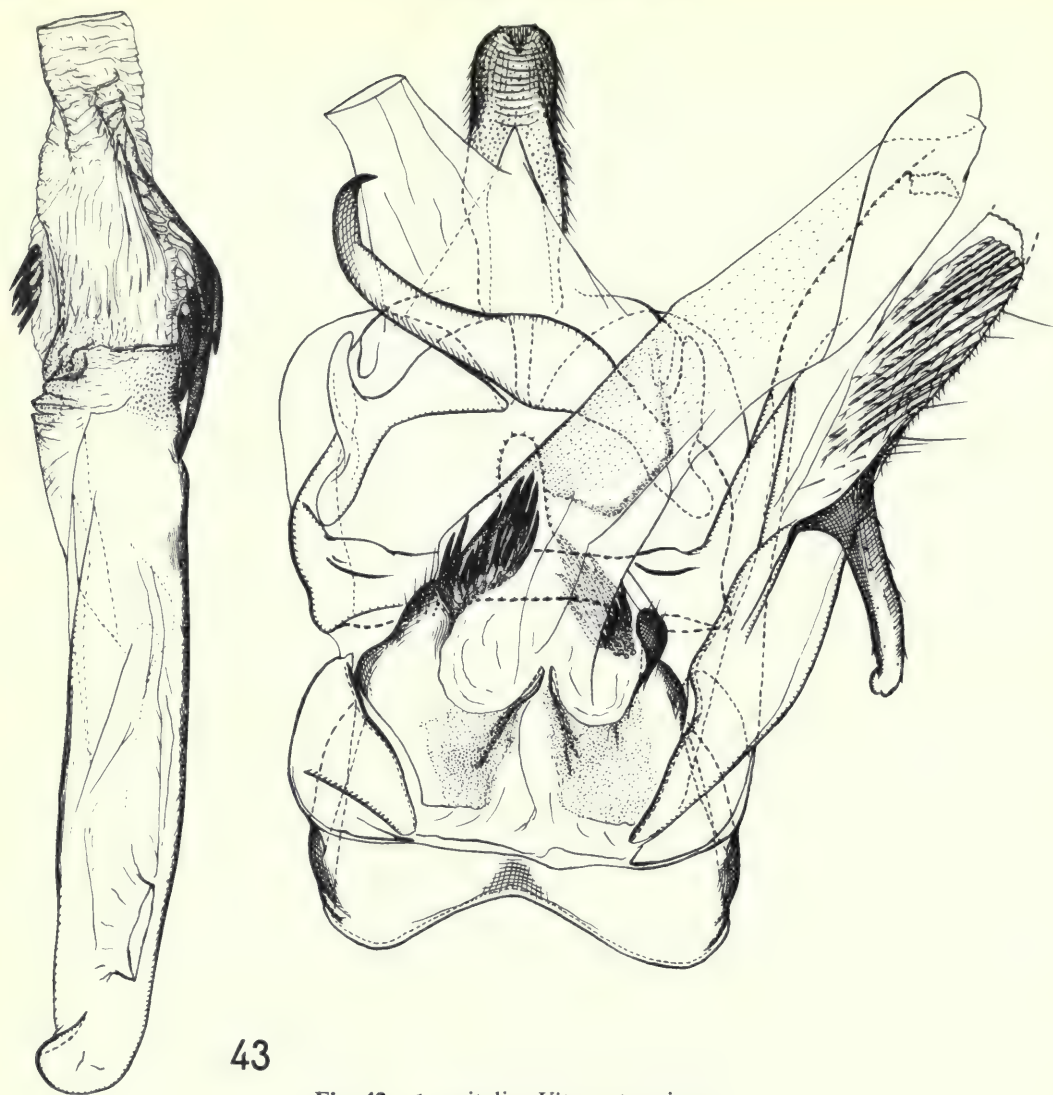


Fig. 43 ♂ genitalia. *Vitessa tamsi* sp. n.

MATERIAL EXAMINED

Holotype ♀, **Samoa**: Upolu, Moamoa, 2.ix.1951 (*Armstrong*) (genitalia slide no. 14629; BMNH).

Paratypes. **Samoa**: 1 ♂ (allotype), 1 ♀, Samoa, 1914–18 (*Tate*) (genitalia slide no. NMNZ 141 = 15301/a, ♂, Shaffer; NMNZ, Wellington); 1 ♀, Upolu, Hellesoi's Paddock, 500 m ('1600 ft'), 15.iii.1953 (*Armstrong*) (genitalia slide no. 15301; BMNH); 1 ♀, Upolu, Tialevi, 10.i.1967 (*Catley*) (BMNH).

The *hieratica*-group

DIAGNOSIS. Fore wing above with orange subbasal area and two whitish transverse fasciae, the latter crowded closer together near medial third of wing than in other groups with black and white hind wing; antemedial fascia complete, postmedial fascia undivided, narrowly oval, not reaching costa or posterior margin as in the few species of succeeding groups with undivided postmedial fasciae. Hind wing with pale medial area, tending to be diffuse on a fuscous background. ♂ genitalia with uncus subpyriform, bearing relatively short, poorly differentiated, laterally directed setae, contrasting with the basally broad, distally rod-like uncus with strong laterally directed setae found in other groups with white areas on hind wing. Valve with oblique serrate clasper and intersecting ridge. Anellus with heavily sclerotized lateral arms in

the form of thick straight bars not bearing spines; dorsal medial catena very large, oval and heavily spined; three cornuti clusters in aedeagus. ♀ genitalia with posterior sclerite of ostial chamber W-shaped, anterior sclerite semicircular and strongly wrinkled; corpus bursae without signa.

Vitessa hieratica Swinhoe, 1900

(Figs 13, 27, 35, 82, 83, 150, 184, 210, 241, 287)

Vitessa hieratica Swinhoe, 1900, *Cat. Eastern and Australian Lepid. Het. Coll. Oxford Univ. Mus.* 2 : 430, pl. 6, fig. 22. Holotype ♂, BORNEO: Sarawak (*Wallace*) (Type no. 873; genitalia slide no. Oxford 717-1977, Shaffer; UM, Oxford) [examined].

♂, ♀. 32–40 mm. Frons and vertex orange. Eye dark brown. Ocellus minute, oval, yellow. Chaetosema with pale yellowish setae. Antenna black, anterior surface of scape orange; dorsal scaling of nearly half apical half of shaft white. Labial palpus: first and second segments orange, third segment black. Maxillary palpus basally black, terminally orange. Basal scaling of proboscis black, ventrally flecked with orange. Neck region orange. Thorax above: orange with wide, medial, longitudinal, blue-black stripe; patagium orange with posteromedial blue-black spot; tegula orange with long anterior and terminal blue-black spots. Abdomen above: blue-black with broad whitish grey terminal lines on segments, anal tuft orange. Body below: fuscous; pectus orange; abdomen as on upperside. Legs fuscous; fore coxa with large orange patch bearing central blue-black spot; mid and hind coxae, femora and tibiae banded with whitish grey. Fore wing short and narrow; above: basal area blue-black with small patch of white at base of posterior margin; subbasal area of irregular width, basally orange and medially white, slightly short of costa but reaching posterior margin, both margins acutely angled at base of cell, sharply widened again to region of *CuP*, then truncated and widened on reaching posterior margin. Antemedial fascia white, reaching margins of wing, at posterior margin narrowly joined to subbasal area, the fascia wide, medially radiating in narrow lines towards postmedial fascia at *R* stem, *Cu*₁, *A*₁ and posterior margin, line at *Cu* touching postmedial fascia. Postmedial fascia white, large, oval, not reaching margins of wing. Dark areas on wings blue-black; terminal area wide with white vein-lines. Fringe greyish fuscous. Hind wing above with basal area whitish, variably suffused with fuscous from margins, costal and distal margins diffusely blue-black. Fringe basally fuscous, distally white. Fore wing below blue-black; retinaculum light grey; postmedial fascia smaller than on upperside; apex and anterior part of fringe narrowly whitish grey, posterior margin white. Hind wing below: as on upperside but with blue-black margin demarcated from whitish basal area. Hind wing of ♀ with well-demarcated margins above and below.

GENITALIA ♂ (Figs 27, 35, 150, 184, 210). Uncus short, laterally swollen at base, distally tapering and with laterally directed setae, tip broadly acuminate. Gnathos long, basal arms nearly straight, tapering distally and converging at an acute angle, medial process strong, tapering, tip hooked. Transtilla strong, shallowly V-shaped, of even width. Tegumen anteriorly directed, posterior and anterior sclerites constricted, anterior margin of anterior sclerite with large posteriorly directed keyhole-shaped emargination; posterior sclerite weak. Vinculum broad, with base slightly concave. Valve long and wide, costa heavily sclerotized and sinuate, valve broadest postmedially, apex narrowly rounded; clasper small, angulate with a curved carina. Juxta with narrow lateral sclerites bearing long dorsal and ventral processes; ventral process supporting base of anellus (Fig. 184); dorsal process (Fig. 27) posteriorly setose and connected to long, straight, heavily sclerotized, unspined, lateral sclerite on anellus, terminally connected to flat, wide, sclerotized bands on manica; long dorsal catena (Fig. 35), narrow, oval, heavily spined. Aedeagus of moderate length, distally expanded, base narrowly rounded; ductus ejaculatorius subbasal; spines on vesica dorsally and ventrally, vesica on ventral surface at distal end of aedeagus bulbous and transversely rugose; dorsal side of vesica between cornuti clusters longitudinally rugose. Three cornuti clusters (Fig. 210); two long curved lateral proximal clusters, right slightly longer than left and with shorter spines; single distal cluster minute with about four spines.

GENITALIA ♀ (Figs 241, 287). Ovipositor lobes high, narrow, dorsally fused and prolonged posteriad; posterior surface densely setose, longer setae on margin, spiny setae visible at ×100 magnification. Posterior apophysis short, narrow, angled slightly near tip. Anterior apophysis short, narrow, angled slightly at base and near tip. Posterior ostial sclerite (Fig. 287) long and wide, with three well-defined and highly sclerotized border regions laterally and anteriorly, a central roughly circular area well defined but not sharply demarcated in sclerotization. Anterior sclerite membranous with sclerotized incurved wrinkled base, laterally denticulate. Antrum broadly oval. Ductus bursae with funnel-shaped swelling posteriorly, lightly spinose. Corpus bursae large, membranous, oval; signa absent.

REMARKS. This rare species is easily distinguished externally from *V. suradeva* and other species with generally similar maculation by the undivided oval postmedial white fascia of the fore wing, connected to the antemedial white fascia by a white streak along Cu_1 . In other species of similar appearance the postmedial fascia is bi- or tripartite and is usually not connected to the antemedial white fascia along Cu_1 . The species is distinct from all other species in both ♂ and ♀ genitalia, as indicated in the diagnosis of the species-group.

BIOLOGY. Early stages and host-plant unknown. Moths collected in January, February, July to September and November.

DISTRIBUTION (Fig. 13). Sumatra; Borneo: Sarawak, Sabah.

MATERIAL EXAMINED

Sumatra: 1 ♀, Benkulen [Bengkulu] [3°47' S, 102°15' E], xi.1921 (*Brooks*) (TM, Pretoria); 1 ♀, Lebong Tandai [3°02' S, 101°56' E], i.1922 (*Brooks*) (BMNH). **Borneo:** 1 ♂, Sarawak, Mt Matang [1°36' N, 110°11' E] (*Mjoberg*) (BMNH); 1 ♀, S., Bidi, 1907–1908 (*Brooks*) (TM, Pretoria); 1 ♀, S., Mt Penrisen [1°07' N, 110°13' E] (*Janse*) (TM, Pretoria); 2 ♀, S., Kuching, Semongok, secondary forest, ii.1976 (*Classey*) (BMNH); 2 ♀, S., Semongok, 19.3 km ('12 mls') south of Kuching, iii, v.1974 (*Earnshaw*) (CNC, Ottawa); 2 ♂, S., Gunong Mulu Nat. Park, Mulu, 1790 m, 452463 lower montane (moss) forest, MV – canopy, i.1978 (*Holloway et al.*) (BMNH); 1 ♂, Sabah, Mt Kinabalu, 'Power Station', 1950 m, vii–ix.1965 (*Holloway*) (BMNH).

The *stettina*-group

DIAGNOSIS. Fore wing above with two transverse whitish fasciae and an orange subbasal area; the postmedial white fascia usually and the antemedial fascia sometimes divided into two or more spots. Hind wing with white or whitish discal area and black terminal margin, the latter narrowing posteriorly. In the ♂ genitalia uncus differentiated into a short, relatively wide basal portion and a long, slender, rod-like, down-turned, then up-turned, distal portion, with conspicuous, laterally directed setae. Valve long, with regular fluting and weak angular clasper. Anellus with undifferentiated spineless sclerotization at junction with dorsal process of juxta. Vesica with three cornuti clusters, but, unlike the condition in previous groups, one cluster basal and two distal. In the ♀ genitalia the posterior ostial sclerite short, wide; anterior sclerite wrinkled and laterally differentiated into three portions; antrum short and wide, merging in outline with funnel-shaped posterior end of ductus bursae. Corpus bursae long and narrow, signa absent. Distinguished from the *hieratica*-group by the shape of the whitish fasciae on the fore wing, by the differentiated uncus of the ♂, and by the structure of the ostial chamber in the ♀. Differing from the *hemiallactis*-, *plumosa*- and *pyraliata*-groups by the weak clasper of the valve and from the *suradeva*-group by the oblique position and more rounded outline of the valve. Differing from all other groups by the anellus of the ♂ lacking a catena, and the corpus bursae of the ♀ lacking signa. The ♀ is distinguished from the *hemiallactis*-group by having the posterior margin of the seventh abdominal sternite straight or concave, not convex.

Vitessa philippina sp. n.

(Figs 14, 84, 242, 288)

♂. Unknown.

♀. 48 mm. Frons and vertex orange. Eye and ocellus dark brown. Chaetosema with yellowish setae. Antenna black, scape basally orange, probably with some white on posterior surface of apical third of shaft (antennae of holotype badly damaged). Labial palpus pale orange from base to near end of second segment, tip of second, all of third segment black. Maxillary palpus basally black, distally pale orange. Basal scaling of proboscis black. Neck region pale orange. Thorax above: black; patagium blue-black, bordered with pale orange; tegula blue-black, anteromedially with faint border of pale orange. Abdomen above blue-black, with narrow whitish grey terminal lines on segments, anal tuft orange. Body below black, but with white terminal lines on segments wider; pectus pale orange; legs black, banded with white. Fore wing long and narrow; above: ground colour blue-black; a subbasal orange spot, roughly triangular, anteriorly not reaching costa, posteriorly extending to A_1 ; white antemedial fascia divided, small spot behind costa, larger triangular spot between Cu and A_1 ; white postmedial fascia oblique, divided into two spots, a circular spot on discocellular vein and a more distal, smaller, triangular spot on CuP , some white scaling anterior to terminal end of this spot; in terminal area white vein-lines from R_4 to M_3 or Cu_1 , well separated from postmedial fascia; fringe dark grey. Hind wing above with base, costa and termen broadly black, anal margin with thin black fringe, narrow black scaling along some veins from base, discal area and middle of anal margin white, faintly nacreous. Fore wing below: postmedial fascia almost as above,

faint traces of antemedial fascia, posterior margin white, remainder black; retinaculum dark grey; fringe apically white, dark grey below. Hind wing below as above.

GENITALIA ♀ (Figs 242, 288). High, narrow ovipositor lobes, dorsally fused and produced posteriorly, densely setose, with longer setae at margin; spiny setae visible at $\times 100$ magnification. Posterior apophysis long, slender and slightly curved. Anterior apophysis similar but thicker and longer. Posterior ostial sclerite (Fig. 288) with irregular transverse wrinkles, posterior margin medially concave, anterior margin deeply incurved but with medial area strongly convex. Anterior sclerite with posterior margin of even width, medially with weak folds, whole margin denticulated, somewhat differentiated into three sections, protruded posterolaterally and rounded, anterior margin membranous, laterally denticulate. Antrum broad and funnel-shaped. Posterior end of ductus bursae swollen, funnel-shaped; short narrow portion of ductus spinose, merging gradually into long, narrow corpus bursae; signa absent.

REMARKS. This has fewer white vein-lines in the terminal area of the fore wing than any other species of the group. In general reduction of markings it closely resembles *V. ternatica* of the *hemiallactis*-group, but it is distinguishable by genitalia. In the Philippines, *V. pyraliata triangulifera* is very similar in appearance, but *V. philippina* is distinguishable by the larger orange subbasal area of the upperside of the fore wing and by lacking white vein-lines on the apical region of the underside of the hind wing. The ♀ genitalia of the species in this group are very similar, but in no other species are the ovipositor lobes so acutely narrowed posteriorly.

BIOLOGY. Early stages and host-plant unknown. Moths collected in April, September and October.

DISTRIBUTION (Fig. 14). Philippines: Luzon, Mindanao.

MATERIAL EXAMINED

Holotype ♀, **Philippines:** Luzon, Manila, 12.ix.1912 (*Wileman*) (genitalia slide no. 14701; BMNH).

Paratypes. **Philippines:** 1 ♀, Mindanao, Davao Province, 30.iv.1930 (*Clagg*) (CM, Pittsburgh); 1 ♀, Mindanao, 24.13 km ('15 mls') SW. Davao, Mt Apo School, 22-31.x.1965 (*Davis*) (NMNH, Washington).

Vitessa stettina Swinhoe, 1906

(Figs 15, 28, 36, 85, 86, 151, 185, 211, 243, 289)

Vitessa stettina Swinhoe, 1906, *Ann. Mag. nat. Hist.* (7) **18** : 412. **LECTOTYPE** ♀, NEW GUINEA: Papua, Granville [Port Moresby] 845 (genitalia slide no. 15305; BMNH), here designated [examined].

♂, ♀. 46–56 mm. Frons and vertex orange. Eye and ocellus brown. Chaetosema with pale yellowish setae. Antenna black; ventral surface of scape mainly or wholly orange; dorsal scaling of basal half of apical third of shaft white. Labial palpus with first two segments orange, third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis black. Thorax above: orange with central round blue-black spot; patagium orange with posteromedial glossy blue-black spot; tegula orange with anterolateral glossy blue-black spot. Abdomen above: blue-black with narrow whitish grey terminal lines on segments, anal tuft orange. Body below: blue-black; pectus orange; abdomen as above with wider terminal lines. Legs blue-black, with faint greenish hue in places; posterior surfaces of fore coxa, mid and hind femora whitish grey; whitish grey bands on mid and hind tibiae. Fore wing long and of moderate width; above: ground colour glossy blue-black, some orange scales at costa; orange subbasal area tapering to near posterior margin in ♀, not passing A_1 in ♂; whitish grey antemedial fascia wide, complete, almost or quite reaching posterior margin, separated from costa by a narrow line of ground colour, basal margin erect, straight, medial margin irregular, diffuse, sometimes joining postmedial fascia, especially along posterior margin; whitish grey postmedial fascia wide, complete, rounded anteriorly, sometimes reaching posterior margin, sometimes indented at Cu_2 , terminal margin sinuate; terminal area with all veins whitish grey; fringe glossy dark grey. Hind wing above: base, costa and termen blue-black with violaceous reflections, white medial area extending broadly to anal margin; fringe glossy dark grey. Fore wing below: bluish fuscous with violaceous reflections; reduced whitish grey postmedial fascia; few whitish grey apical vein-lines; posterior margin white; retinaculum dark grey; fringe dark grey. Hind wing below as above, apical part of costa, few apical vein-lines and anterior portion of fringe whitish grey.

GENITALIA ♂ (Figs 28, 36, 151, 185, 211). Uncus long, narrow, basally widened, distally tapering with long laterally directed setae, down-curved then up-curved, apex sharp. Gnathos with flat lateral arms converging gradually to the rounded, hook-like, acuminate medial process. Transtilla gently curved to centre,

medially widened. Tegumen: posterior sclerite with wide rounded shoulders, anterior sclerite posteriorly directed medially with large keyhole-shaped medial emargination. Vinculum broad, basally truncated. Valve long, narrow, costa inflated, apex moderately rounded, termen broadly rounded, posterior margin almost straight for most of length; narrow longitudinal striations on mesal surface; clasper short, oblique, slightly separated from curved carina, a small serrate ridge ending ventrally before margin in a basally directed tooth-like process. Juxta with large narrow lateral sclerites, ventral process strongly upturned, flat, narrow and twisted, supporting base of anellus (Fig. 185); dorsal process shorter, wider, bearing setae, connected to sinuate, distally reticulated sclerite supporting side of anellus (Fig. 28); medial to tips of sclerites are two small irregular sclerotized and ridged areas (Fig. 36); in continuation with sclerites, flat sclerotized bands supporting base of manica. Aedeagus of moderate length, distally expanded, base narrowly rounded; ductus ejaculatorius subbasal. Vesica with spines spreading ventrally to distal end of aedeagus, here the vesica bulbous and transversely rugose; vesica wide to just beyond area of cornuti, membrane between cornuti clusters longitudinally rugose; cornuti (Fig. 211) in three clusters, a single small basal cluster with tight pack of small spines, two larger distal clusters with longer spines, left cluster shorter than right.

GENITALIA ♀ (Figs 243, 289). Ovipositor lobes high, narrow, dorsally fusing, posteriorly produced; posterior surface densely setose, longer setae on margin, spiny setae visible at $\times 100$ magnification. Posterior apophysis long, slender, weakly curved, blunt; anterior apophysis longer, thicker, blunt; Posterior ostial sclerite (Fig. 289) broad, longitudinally wrinkled, posterior margin with medial thickened bar, anterior margin medially upturned, with prominent curved flap, margin finely denticulated; anterior sclerite broad, posterior margin concave, slightly wrinkled, denticulate, differentiated into three slightly overlapping denticulate plates, each rounded posteriorly, lateral plates posterolaterally protruded; antrum wide and fairly long, conforming with swollen end of ductus bursae, cup-shaped; ductus bursae minutely spinose, short, merging imperceptibly with elongated narrow corpus bursae; signum absent.

REMARKS. This species most closely resembles externally the superficially almost identical *V. intermedia* of the *hemiallactis*-group, with which it flies, at least at higher altitudes, in New Guinea. It can be distinguished from *V. intermedia* by having less diffusion of white into the medial area of the fore wing; in *V. intermedia* the fusion between the white fasciae is more extensive, showing little of the blue-black medial area. The species-group characters of the genitalia are of course diagnostic. In the ♀ a quick diagnosis for all the *stettina*-group can be made by dry examination of the posterior margin of the ventral posterior sternite; this is lightly sclerotized and fairly straight in the *stettina*-group, heavily sclerotized and convex in the *hemiallactis*-group, showing as pale yellowish brown in the former and dark reddish brown in the latter, the colours being enhanced by using toluene. *V. stettina* is distinct from others in the group in the greater development of the white fore wing fasciae. It is distinct from all other species in the ♂ genitalia, as far as known, by the shape of the valve and clasper and especially by the absence of dorsal catena spines on the anellus; and in the ♀ genitalia by the shape of the anterior ostial sclerite and by the absence of signa.

BIOLOGY. Early stages and host-plant unknown. Moths collected in most months of the year.

DISTRIBUTION (Fig. 15). Waigeo; New Guinea: Irian Jaya, Papua New Guinea.

MATERIAL EXAMINED

Paralectotypes. **New Guinea:** 1 ♀, Papua New Guinea, data as lectotype (genitalia slide no. 15321; BMNH); 5 ♂, 6 ♀, P. N. G., Mount Kebea, 1100–1850 m, iii–viii.1903 (*A. E. Pratt*) (BMNH). [1 ♂, 1 ♀, see under paratype series of *Vitessa intermedia* (p. 299).]

Waigeo: 1 ♂, 1 ♀, 1904 (*Waterstradt*) (BMNH). **New Guinea:** 1 ♀, Irian Jaya, Ninay Valley, Central Arfak Mts, 1050 m, ii–iii.1909 (*Pratt*) (BMNH); 1 ♂, 2 ♀, I. J., Nomnagihe, 40–23 km south of Wangaar, 600 m, i–ii.1921 (*C. F. & J. Pratt*) (TM, Pretoria); 1 ♀, I. J., Hollandia [Sukarnapura], iii.1960 (*Maa*) (BPBM, Honolulu); 1 ♀, I. J., Hollandia area, Sentani, 100 m, vi.1959 (*Gressitt & Maa*) (BPBM, Honolulu); 1 ♀, I. J., Waris, S. of Hollandia, 450–500 m, viii.1959 (*Maa*) (BPBM, Honolulu); 1 ♂, no data (*Janse*) (TM, Pretoria); 4 ♂, 3 ♀, Papua New Guinea, Sepik District, Bainyik, 300 m, x–xi.1957 (*Munroe & Holland*) (CNC, Ottawa); 4 ♀, P. N. G., Ekeikei, 450 m, i–iv.1903 (*Pratt*) (BMNH); 1 ♀, P. N. G., Mount Kebea, 1100–1850 m, iii–viii.1903 (*A. E. Pratt*) (CMAG, Birmingham); 1 ♀, P. N. G., Mafalu, 1850 m, viii.1903 (*Pratt*) (BMNH); 1 ♀, P. N. G., Babooni, 1100 m, ix.1903 (*Pratt*) (BMNH); 37 ♂, 16 ♀, P. N. G., Sogeri Plateau, Mageri, viii.1957 (*Munroe & Holland*) (CNC, Ottawa); 2 ♂, 2 ♀, P. N. G., Sogeri Plateau, Bisianumu, viii.1957 (*Munroe & Holland*) (CNC, Ottawa); 1 ♂, P. N. G., Port

Moresby, Mt Lawes, 400 m, iii-v.1967 (Brandt) (ANIC, Canberra); 1 ♂, 2 ♀, P. N. G., Hydrographer Mts, 750 m, ii-iii.1918 (Eichhorn Bros.) (BMNH).

***Vitessa hollandi* sp. n.**

(Figs 16, 17, 87-90, 152, 153, 186, 187, 244, 245, 290, 291)

♂, ♀. 36-50 mm. As in *V. stettina*, except as follows. Only base of scape ventrally orange. Thorax above: variable, orange, yellowish white or greyish white with blue-black medial spot variable in size; patagium orange with large posteromedial glossy blue-black spot; tegula glossy blue-black, laterally orange. Abdomen above with narrow whitish grey terminal lines on first three segments only; below with broad whitish grey terminal lines on most segments. Fore wing appearing narrower; upperside with large orange subbasal area not reaching costa or passing A_1 , basally acutely angled, medially obliquely curved. Antemedial fascia white, basal edge nearly straight and erect, slightly short of both costa and posterior margin, broadly indented or divided at cell, medially broadened and diffuse; postmedial fascia broad, divided into two spots at about CuP , upper spot large and round, lower spot triangular, sometimes with small white spot terminally above, regularly followed by a streak on posterior margin, often fusing with medial extension of antemedial fascia. Hind wing above with white medial area variably extended to anal margin, anal margin with thin black scaling. Fore wing below: postmedial fascia complete and obliquely oval, or divided at CuP , spots as on upperside.

GENITALIA ♂ (Figs 152, 153, 186, 187). In general as described for *V. stettina*. Valve apex narrowly rounded, termen short, posterior margin broadly rounded.

GENITALIA ♀ (Figs 244, 245, 290, 291). In general as described for *V. stettina*, but see Remarks.

REMARKS. This species is nearly indistinguishable in genitalia from the largely allopatric *V. stettina*; in the ♂ genitalia the valve apex is more narrowly rounded and the termen more acute; in the ♀ genitalia the lateral margins of the antrum (Figs 290, 291) and the swollen end of the ductus bursae are more oblique than in *V. stettina*. The antenna appears to be more slender in both sexes in the present species. Externally, the reduced pale markings of the upperside of the fore wing are distinctive from *V. stettina*, but are deceptively similar to those of *V. hemiallactis* of the *hemiallactis*-group, with which *V. hollandi* flies. The posteriorly tapering terminal band of the hind wing usually distinguishes the present species from *V. hemiallactis* and the genitalia are very distinct in both sexes (see species-group diagnoses, also Remarks under *V. stettina*). *V. hollandi* is superficially indistinguishable from *V. gemina* of the *pyraliata*-group but again differs in genitalia (see species-group diagnosis). We recognize two subspecies, one from New Guinea and the Kepulauan Schouten, the other from Sulawesi. Limited material from the Moluccas and New Britain may represent further subspecies. We take pleasure in dedicating this species to Dr G. P. Holland, co-collector of the holotype, and companion of the senior author in a highly productive collecting expedition to Papua New Guinea.

BIOLOGY. Early stages and host-plant unknown. Moths collected in almost every month of the year.

DISTRIBUTION (Figs 16, 17). Sulawesi; Moluccas; New Guinea; Kepulauan Schouten; New Britain.

***Vitessa hollandi wallacealis* subsp. n.**

(Figs 17, 87, 88, 152, 186, 244, 290)

♂, ♀. 36-46 mm. Generally as described for species. Thorax above: anteriorly orange, posteriorly whitish grey, large arrow-shaped medial blue-black spot; patagium orange with very large posteromedial glossy blue-black spot; tegula glossy blue-black, laterally yellowish white. Fore wing above: subbasal area orange tinged with yellow; antemedial fascia white, divided at cell into two spots in ♂ and mostly in ♀; postmedial fascia divided into two spots at CuP ; terminal white vein-lines very weak posterior to Cu_1 , touching postmedial fascia at Cu_1 . Hind wing above: blue-black marginal band wide, its basal margin less strongly concave than in nominate subspecies, basal white area restricted. Fore wing below: postmedial fascia with strong round spot but weak triangular spot; white apical lines hardly visible. Hind wing below: white apical lines hardly visible.

GENITALIA ♂ (Figs 152, 186). Generally as described for species. Valve narrow; uncus gradually tapering from basal section.

GENITALIA ♀ (Figs 244, 290). As described for species.

REMARKS. This is distinguished from the nominate subspecies by the narrower and generally restricted white markings; the antemedial fascia is mostly divided into two spots. On the hind wing the black border is broader in the middle of the wing, its basal margin is less strongly concave, and the white area is more restricted, especially in the ♂. The underside markings are greatly reduced; the postmedial fascia on the fore wing is divided into two spots, whereas it is generally a single large spot in *V. hollandi hollandi*; on the hind wings the apical white lines are reduced. In the ♂ genitalia the uncus tapers more evenly and the valve is narrower (see also Remarks under *V. hollandi hollandi*).

BIOLOGY. Early stages and host-plant unknown. Moths collected in May and June.

DISTRIBUTION (Fig. 17). Sulawesi: central, north-eastern and south-eastern regions.

MATERIAL EXAMINED

Holotype ♂, **Sulawesi**: Menado (*Van Braeckel*) (genitalia slide no. 14635; BMNH).

Paratypes. **Sulawesi**: 1 ♀ (allotype), data as holotype (BMNH); 2 ♀, Paloe, Sidaonta, 1350 m ('4500 ft'), vi.1937 (*Kalis*) (genitalia slide no. 15308; BMNH); 1 ♀, Paloe, Koelawi 1°25' S, 119°58' E, 950 m ('3100 ft'), iii.1937 (*Kalis*) (genitalia slide no. 14686; BMNH); 1 ♀, Paloe, Loda, 1200 m ('4000 ft'), v.1937 (*Kalis*) (BMNH); 2 ♀, Minahassa, Tomohon, 1-9.vi & 26-29.vii.1954 (*Alston*) (genitalia slide no. 15307; BMNH); 2 ♀, Ulu Kolaka, 500 m, v-vi.1939 (*Kalis*) (BMNH).

Vitessa hollandi subsp.

The following two specimens probably represent a distinct subspecies, but without more material we prefer not to name it.

♂, ♀. 46-50 mm. Fore wing above: orange subbasal area of similar size to that of *V. hollandi wallacealis*; antemedial fascia indented but not interrupted, wider than in *V. hollandi hollandi* though not as wide as in *V. stettina*; postmedial fascia oblique, divided into two spots, as in *V. hollandi hollandi*. Hind wing above with tapering black terminal band. White markings on underside of both wings as in *hollandi hollandi*.

DISTRIBUTION. Moluccas.

MATERIAL EXAMINED

Moluccas: 1 ♂, Batjan, viii.1897 [abdomen missing] (*Doherty*) (BMNH); 1 ♀, Obi, Laiwui, ix.1897 (*Doherty*) (BMNH).

Vitessa hollandi hollandi subsp. n. (Figs 16, 89, 90, 153, 187, 245, 291)

[*Cosmethis suradeva* (Moore); Janse, 1928 : 88. Misidentification.]

♂, ♀. 40-50 mm. Generally as described for species. Thorax above: orange with large arrow-shaped medial blue-black spot; patagium orange with large posteromedial glossy blue-black spot; tegula glossy blue-black, laterally pale orange. Fore wing above: subbasal area orange; antemedial fascia white, broadly indented at cell; postmedial fascia white, divided into two spots, upper large round spot over discocellular vein, not reaching costa, lower triangular spot over *CuP*, smaller dot above, between *Cu*₁ and *Cu*₂; white streak along posterior margin joining streak from antemedial fascia; terminal area with white vein-lines, sometimes absent on *CuP*, touching postmedial fascia at *A*₁. Hind wing above: blue-black terminal band wide at apex, gradually tapering, narrow near anal margin. Fore wing below: postmedial fascia with large round spot and adjoining lower marking; white apical lines weak. Hind wing below: white apical lines weak.

GENITALIA ♂ (Figs 153, 187). Generally as described for species. Valve broad; uncus with basal and distal sections well demarcated.

GENITALIA ♀ (Figs 245, 291). As described for species.

REMARKS. The subspecies is restricted to New Guinea and adjacent islands; it is rarer in Papua, where *V. stettina* occurs sympatrically, than in north-eastern New Guinea. In New Guinea it

occurs with *V. hemiallactis hemiallactis*, which it closely resembles externally (see Remarks under *V. hollandi* and *V. stettina*, pp. 288–289; for distinguishing features from *V. hollandi wallacealis* see Remarks under the subspecies, above). In Kepulauan Schouten *V. hollandi hollandi* bears a similar relation to *V. gemina* (p. 312). We have not examined the specimen recorded by Janse as *V. suradeva* from Mefor, Kepulauan Schouten. It may be referable to this subspecies or to *V. gemina*. It is almost certainly not *V. suradeva*.

BIOLOGY. Early stages and host-plant unknown. Moths collected in most months of the year.

DISTRIBUTION (Fig. 16). Kepulauan Schouten; New Guinea: Papua New Guinea.

MATERIAL EXAMINED

Holotype ♂, **New Guinea**: Papua New Guinea, Finisterre Mts, Wantoat, 1200 m ('4000 ft'), 13.ix.1957 (*Munroe & Holland*) (genitalia slide no. DK 113; CNC, Ottawa; type no. 11,021).

Paratypes. New Guinea: 3 ♀, Papua New Guinea, vic. Wewak, Koigin, 350 m ('1200 ft'), 22–24.x.1957 (*Munroe & Holland*) (CNC, Ottawa); 3 ♀, P. N. G., Sepik District, Padwe R., 26.x.1957 (*Munroe & Holland*) (CNC, Ottawa); 30 ♀, P. N. G., Sepik District, Bainyik, 350 m ('1200 ft'), 29.x.–28.xi.1957 (*Munroe & Holland*) (genitalia slide no.'s DK 133, DK 134, DK 136; CNC, Ottawa); 1 ♀, P. N. G., Astrolabe Bay (*Wahnes*) (genitalia slide no. 15336; BMNH); 2 ♂, 32 ♀ (including allotype), P. N. G., data as holotype, 5.ix.1957 (genitalia slide no.'s DK 114, 15336/a, Shaffer; CNC, Ottawa); 6 ♀, P. N. G., Morobe District, *Araucaria* Forest, Bulolo, 1200 m ('4000 ft'), 23.ix.1957 (*Munroe & Holland*) (genitalia slide no.'s DK 112, DK 120; CNC, Ottawa); 3 ♀, P. N. G., Hunstein-Gebirge, Wagu/Black River, i–ii.1973 (*Hohmann*) (UM, Bremen); 2 ♀, P. N. G., Mount Kebea, 1100 m ('3600 ft'), iii.viii.1903 (*A. E. Pratt*) (genitalia slide no.'s 15329, 15335; BMNH); 4 ♀, P. N. G., Sogeri Plateau, Mageri, 500 m ('1600 ft'), 15.viii.1957 (*Munroe & Holland*) (genitalia slide no.'s DK 517, DK 520, DK 521; CNC, Ottawa); 1 ♂, P. N. G., Sogeri Plateau, Bisianumu, 500 m ('1600 ft'), 11.viii.1957 (*Holland*) (genitalia slide no. DK 175; CNC, Ottawa); 1 ♀, P. N. G., Bisianumu, NE. of Port Moresby, 150 m, vi.1957 (*Hardy*) (BPBM, Honolulu).

Material excluded from paratype series. **Kepulauan Schouten**: 1 ♀, Mefor ('Numfoor'), Suer, v–vi.1897 (*Doherty*) (BMNH). **New Guinea**: 1 ♀, P. N. G., Mount Kebea, 1100 m., vii.1903 (*A. E. Pratt*) (fore wing, thorax and head of *V. hemiallactis hemiallactis*; hind wing and abdomen, glued on, of *V. hollandi hollandi* (BMNH)).

Vitessa hollandi subsp.

The following specimen probably represents a distinct subspecies, but without more material we prefer not to name it.

♀. 50 mm. Fore wing above: orange subbasal area of similar size to that of *V. hollandi hollandi*; narrow antemedial and postmedial fasciae divided into two spots as in *V. hollandi wallacealis*, but lower spot of postmedial fascia more oblique; terminal area with white vein-lines much shorter than in any other subspecies, from M_3 to Cu_2 . Hind wing above and white markings on underside of both wings as in *V. hollandi hollandi*.

DISTRIBUTION. Bismarck Archipelago: New Britain.

MATERIAL EXAMINED

Bismarck Archipelago: 1 ♀, New Britain, Yalom, 1000 m, v.1962, at mercury vapour light (ZM, Copenhagen).

The *hemiallactis*-group

DIAGNOSIS. Wing markings either like those of *stettina*-group, or with the pale fasciae on the upperside of fore wings greenish, expanded and partly or wholly merged, leaving a wedge-shaped black spot in cell. Hind wing with white medial area and contrasting black terminal band. ♂ genitalia with uncus basally wide, distally rod-like, with a row of laterally directed setae on each side. Valve less regular in outline than in *stettina*-group, posterior margin concave at centre; clasper larger and more prominent than in *stettina*-group, forming a finely serrulate ridge, differing from the coarsely serrate ridge of the *pyraliata*-group and the bifid process of the *plumosa*-group; costal margin of valve weakly curved subbasally and valve oblique in dorsoventral preparation, as compared with the strongly curved costa and horizontal valve of the *suradeva*-group. Large dorsal catena present on anellus. Cornuti consisting of three clusters, two basal dorsolateral and one distal ventrolateral. ♀ genitalia with much heavier ostial sclerotization than in

stettina-group, similar to that of *pyraliata*-group. Posterior sclerite with lateral prolongations anteriorly directed; anterior sclerite recurved and wrinkled, differentiated at centre, forming an anteriorly directed pouch; antrum greatly extended posteriorly to form a trapezoidal plate fitting between the prolonged sides of the posterior sclerite. Corpus bursae with signa consisting of paired denticulate areas. ♀ seventh abdominal segment with posterior margin convex, not concave or straight as in *stettina*-group.

***Vitessa ternatica* Lederer, 1863**

(Figs 17, 91, 92, 154, 188, 212, 246, 292)

Vitessa ternatica Lederer, 1863, *Wien. ent. Monatschr.* 7 : 335, 456, pl. 6, fig. 7. Holotype ♀, MOLUCCAS: [Ternate] ex Felder coll. (genitalia slide no. 15306; BMNH) [examined].

Vitessa ternatica Lederer; Hampson, 1896a : 503.

Vitessa sarumensis Holland, 1900, *Novit. zool.* 7 : 582. LECTOTYPE ♀, MOLUCCAS: Buru (*Doherty*) (genitalia slide no. 155 DK; CM, Pittsburgh), here designated [examined]. **Syn. n.**

♂, ♀. 42–44 mm. Frons orange. Vertex orange admixed with black. Eye, ocellus fuscous. Chaetosema with pale yellowish setae. Antenna black, ventral surface of scape orange at base; dorsal scaling of basal half to three-quarters of apical third of shaft white; terminal segments pale fuscous. Labial palpus: first segment orange, second segment orange with black admixed distally, third segment black. Maxillary palpus basally black, distally orange. Proboscis basally black. Thorax above: blue-black, with an orange line anteriorly, terminally and laterally marked with greyish white; patagium glossy blue-black, anteriorly and laterally admixed with orange; tegula glossy blue-black, anteromedially and laterally orange. Abdomen above black, some pale grey laterally, terminal margins of segments narrowly pale grey, anal tuft orange. Body below fuscous; pectus orange; abdomen black, terminal margins of segments pale grey, anal tuft orange. Legs black, ventral surfaces of mid and hind femora white, mid tibia with white band at centre, tips of mid and hind tibiae and spurs white. Fore wing long and narrow; above: glossy blue-black; orange subbasal area restricted to small spot on *CuP* with isolated orange scales above and at base; antemedial fascia white, single triangular spot on *CuP*, sometimes minute dot near costa; postmedial fascia white, divided into two spots, large round spot over discocellular vein, more distal smaller spot on *CuP*; terminal area with white vein-lines on most veins, as far as *Cu*₂ in ♂; fringe basally dark grey, distally light grey. Hind wing above mostly blue-black with violaceous reflections, white medial area small, comma-shaped, directed towards base; fringe basally dark grey, distally white at apex, continuing as light grey to anal margin. Fore wing below: blue-black with violaceous reflections; retinaculum rosy pale grey; post-medial fascia forming one large oblique oval spot in ♂; similar to that of upperside in ♀; apex with white vein-lines from *R*₄ to *Cu*₁; posterior margin white; fringe as above. Hind wing below similar to upperside, but apex with white lines from costal margin to *Cu*₁.

GENITALIA ♂ (Figs 154, 188, 212). Uncus fairly long, slender, basal third wider and flattened, distal two-thirds rod-like, laterally setose, recurved, then up-turned, terminally blunt. Gnathos with lateral arms wide, posteriorly curved, central portion compressed, sickle-shaped and acuminate. Transtilla broadly V-shaped, medially widened. Tegumen with posterior sclerite semicircularly expanded, anterior sclerite with anterior margin strongly angled at centre with keyhole-shaped emargination. Vinculum broad and basally convex. Valve long and broad; costa inflated, termen shallowly rounded, meeting costa at right angles, posterior margin broadly concave at centre; striations on mesal surface fine; clasper ridge prominent, oblique, joining carina ridge; at mid-length rising to isolated acuminate peak, falling gradually with two or more minor points, parallel to mesal surface for short distance, rising and rounded with serrate edge to posterior margin. Juxta with large narrow lateral sclerites; ventral process wide at base, strongly up-turned, abruptly narrowing; dorsal process broadly rectangular, bearing setae at tip, joined to heavily sclerotized and almost tubular lateral sclerite on anellus (Fig 188); sclerite connected to dorsal catena via heavily sclerotized ridged bars; catena with compressed spines posteriorly, longitudinal ridges anteriorly; manica with light sclerotization for most of length. Aedeagus long, distally tapering, base narrowly rounded; ductus ejaculatorius nearly subbasal. Vesica with spines spreading ventrally to distal end of aedeagus, membrane in this region bulbous and transversely rugose; vesica wide to just beyond area of cornuti, membrane anterior to cornuti longitudinally rugose and spinose; cornuti (Fig. 212) with two basal dorsolateral clusters, left cluster broadly connected with gradually shortening spines to heavily sclerotized cap at angle of reflexion, right with almost isolated cluster of spines connected to cap by very thin bar; posterior ventral cluster isolated and opposite to cap.

GENITALIA ♀ (Figs 246, 292). High, narrow ovipositor lobes, dorsally fused, posteriorly produced; surface densely setose, longer setae on margin, spiny setae visible at $\times 100$ magnification. Posterior apophysis short, slender, curved, tip truncated. Anterior apophysis much larger, thicker, curved, tip truncated.

Posterior sclerite of ostial chamber (Fig. 292) with lateral prolongations anteriorly directed; membrane above finely denticulate; posterior margin broadly concave, medial anterior margin slightly projected to meet antrum; anterior sclerite well developed, ventrally with recurved broad band, slightly wrinkled, membrane beyond finely denticulate, sclerite laterally widening and greatly extended anteriorly, combining with antrum to form a high wide dorsal surface; antrum extended posteriorly into a trapezoidal plate fitting between the lateral prolongations of posterior margin. Basal end of ductus bursae wide and stretched at junction with broad antrum, remainder of ductus narrow, spinose. Corpus bursae oval, bearing small paired denticulate areas.

REMARKS. The small size and greatly reduced antemedial fascia and orange subbasal area give this species a distinctive appearance; the broadly dark anal margin of the hind wing and the enclosed comma-shaped white area distinguish the species from *V. hemiallactis moluccana*. We find no obvious differences in specimens from the Moluccan localities. The New Guinea ♂ has white markings on the fore and hind wings noticeably reduced; this locality is questionable for the specimen bears no other data though it is labelled as coming from the de Joannis collection. The genitalia of both sexes are distinct from those of other species in this group; the clasper on the valve of the ♂ and the great length of the antrum in the ♀ are the most striking features.

BIOLOGY. Early stages and host-plant unknown.

DISTRIBUTION (Fig. 17). Moluccas: Ternate, Buru, Seram; New Guinea.

MATERIAL EXAMINED

Moluccas: 2 ♀, [Ternate] ex Felder coll. (BMNH); 1 ♂, 3 ♀, Buru (*Doherty*) (CM, Pittsburgh; CNC Ottawa) (paralectotypes of *Vitessa sarumensis* Holland); 1 ♀, Seram, Wahaai (*Moens*) (RNH, Leiden); 1 ♀, Seram (*R.*) (RNH, Leiden); 1 ♀, Seram, Jilo (BMNH); 1 ♀, Seram (BMNH); 2 ♀, no data, ex Moore coll. (BMNH); 1 ♀, no data (*Piepers*) (RNH, Leiden). **New Guinea:** 1 ♂, no data, 1920–1932 coll. L. & J. de Joannis (MNHN, Paris).

Vitessa sp.

(Figs 93, 155, 189)

The following specimen represents a distinct species, but because it bears very dubious data we prefer not to name it.

♂. 44 mm. Generally as described for *ternatica*. Frons and vertex bright dark orange. Antennae missing. First two segments of labial palpus orange, third segment missing. Thorax blue-black, posteriorly bordered with white; patagium anteriorly orange, posteriorly glossy blue-black; tegula glossy blue-black, anteriorly flecked with orange. Fore wing above, subbasal area bright dark orange, extending from costa to A_1 ; white antemedial fascia extending from costa to A_1 , medially diffuse; white postmedial fascia divided into two spots, anterior round spot over discocellular vein, posterior triangular spot over CuP directly behind anterior spot; terminal area with white vein-lines; fringe missing. Hind wing with very broad blue-black margin, white area much restricted by infuscation from base; fringe basally dark grey, distally white.

GENITALIA ♂ (Figs 155, 189). Generally as described for *V. ternatica*. Clasper on valve a prominent oblique ridge, at mid length rising to isolated acuminate peak, curving convexly to posterior margin with irregular serrations. Cornuti consisting of three clusters, left dorsolateral cluster with long sclerotized base and small cluster of spines distally; right dorsolateral cluster consisting of a few sclerotized spine bases; single ventral cluster a tight pack of shorter spines.

REMARKS. This distinctive species seems mid way in some of its features between *V. ternatica* and *V. hemiallactis*. It bears a strong resemblance to *V. hemiallactis moluccana* but is distinguished by the orange subbasal area reaching the costa, and by characters of the genitalia. In accordance with resemblances already noted between other species within *Vitessa* which occur in the same island or island-group it is reasonable to assume that this species might originate from the Moluccas or somewhere nearby. The data label gives Japan, but it has been confirmed by Dr H. Inoue (*in litt.*) that no Pyralinae of this genus or any moths resembling this species are known from the Japanese Islands. The genus occurs as far north as north India, Burma and north Vietnam, but in the Pacific is not known to extend north of Luzon in the Philippines. It is possible that the label is a misspelling of Japen (Kepulauan Schouten), but the Rev. J. C. E. Riotte

informs us there is no direct evidence at the BPBM of the true provenance of this specimen or others similarly labelled.

MATERIAL EXAMINED

Locality unknown: 1 ♂, Japan (BPBM, Honolulu).

Vitessa hemiallactis Meyrick, 1887

(Figs 17–19, 29, 37, 94–101, 156–159, 190–193, 213, 247–250, 293–296)

Vitessa hemiallactis Meyrick, 1887 : 193.

♂, ♀. 40–56 mm. Frons and vertex orange, sometimes admixed with black scales. Eye and minute ocellus brown. Chaetosema with pale yellowish setae. Antenna black, anterior surface of scape basally orange; dorsal scaling of apical third of shaft white to a variable extent, last several segments black. Labial palpus: first segment orange; second segment orange, distally black; third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis black, sometimes laterally admixed with orange. Neck region orange. Thorax above with variable amounts of blue-black, anteriorly with some orange, posteriorly yellowish white; patagium either orange with large posteromedial glossy blue-black spot, or mostly glossy blue-black with anterior margin orange; tegula orange with anterolateral glossy blue-black spot and distally admixed with blue-black, or mostly blue-black with some anteromedial and outer orange scaling, or entirely blue-black. Abdomen above: matt black, posterior margins of segments with variable amounts of whitish grey, terminal segment posteriorly bordered with orange, anal tuft orange. Body ventrally and laterally blue-black; pectus orange; whitish grey abdominal lines broader than above; posterior half of terminal segment and anal tuft orange. Legs blue-black with variable amounts of white banding, a few orange scales at base of fore coxa. Fore wing rather narrow in ♂, broader in ♀; above: ground colour blue-black; orange subbasal area variable in size, not reaching costa or posterior margin; two whitish grey transverse fasciae of variable width, sometimes irregularly extending medially but never joining; antemedial fascia sometimes as wide as postmedial fascia, indented at cell or divided, variable amounts of medial diffusion; postmedial fascia broad or narrow, medially and terminally indented behind cell or divided; terminal area with variably developed white vein-lines, not reaching postmedial fascia; fringe dark grey. Hind wing above: blue-black marginal band with violaceous reflections, of variable width; black anal margin variable in width; large white medial area broadly oval or rounded; fringe dark grey basally, distally with variable amounts of whitish grey towards apex. Fore wing below: black with violaceous reflections; posterior margin variably suffused with light brown; postmedial fascia larger than above, complete or divided at Cu_2 , sometimes medial streaking between Cu_2 and CuP ; terminal area with apical white vein-lines; retinaculum dark grey. Hind wing below as above, with or without white apical vein-lines, these reaching termen when present.

GENITALIA ♂ (Figs 29, 37, 156–159, 190–193, 213). Uncus slender, basally flattened and laterally constricted, abruptly narrowing, terminal portion narrow, rod-shaped, decurved then up-turned with sparse laterally directed setae, tip blunt. Gnathos with widely arched lateral arms and compressed sickle-shaped medial process, tip finely acuminate. Transtilla shallowly V-shaped with strong S-shaped lateral flexure. Tegumen: posterior sclerite broad, rounded; anterior sclerite with wide medial emargination. Vinculum broad, basally concave. Valve narrow at base, widely inflated distally; costa sinuate, basally inflated; termen broadly rounded; posterior margin deeply excised medially; mesal surface with fine longitudinal converging striations; clasper a variably serrulate, continuous, diagonal ridge, with small curved carina at base. Juxta with large narrow lateral sclerites, ventral process flat, narrow and up-turned; dorsal process (Fig. 29) broader, bearing setae, directly connected to sclerotized flat sclerite supporting side of anellus (Figs 190–193), sclerotization finely reticulated dorsally, longitudinally ridged; between sclerites a large, narrow, heavily sclerotized catena (Fig. 37), constricted anteriorly, deeply ridged, posteriorly with multiple spines; manica supported by lightly sclerotized bands. Aedeagus long, distally and basally expanded, base narrowly rounded; ductus ejaculatorius subbasal; vesica with spines spreading ventrally to distal end of aedeagus, here membrane bulbous and transversely rugose; vesica evenly tapering distally, membrane between cornuti clusters longitudinally rugose; cornuti (Fig. 213) in three clusters, two basal dorsolateral clusters bearing large spines, left cluster longer than right, and a single distal ventrolateral cluster bearing smaller spines.

GENITALIA ♀ (Figs 247–250, 293–296). High, narrow ovipositor lobes, dorsally fusing, posteriorly produced; surface densely setose, larger setae on margin, spiny setae easily visible at $\times 100$ magnification. Posterior apophysis short, slender, curved or straight; tip blunt, not expanded; anterior apophysis longer, thicker, tip slightly spatulate. Posterior ostial sclerite (Figs 293–296) with lateral prolongations

anteriorly directed, posterior margin straight or broadly convex, anterior margin medially concave; anterior sclerite ventrally with recurved broad band, slightly wrinkled, finely denticulate, bearing broad, curved medial pouch and much smaller lateral pouches; broad trapezoidal wall of antrum extending posteriorly between lateral prolongations of posterior sclerite, antrum extending anteriorly, ending in a broad curved margin; sclerotization at base of ductus seminalis; ductus bursae slightly expanded posteriorly, remainder narrow, minutely spinose; corpus bursae globular, bearing small paired denticulate areas.

REMARKS. This species is related to *V. ternatica*, but the ♂ genitalia differ considerably in the shape of the valve and clasper; in the ♀ genitalia the antrum, though sharing the posteriorly developed trapezoidal wall, is not nearly as long anteriorly. Externally *V. hemiallactis* is more lustrous, with the white area on the hind wing relatively larger and with at most a narrow black band along the anal margin. The various subspecies are easily confused externally with those of the *stettina*-group (see Remarks under *V. hollandi*), and the subspecies *admiralitatis* and *lustrans* strongly resemble the various species of the *pyraliata*-group, though these are not known to occur in the same geographical areas; nevertheless, they are easily distinguishable in the genitalia, as pointed out in the diagnosis of the species-group. In genitalia *hemiallactis* is closely similar to other species in its own group, but it is distinct externally. We recognize four subspecies, from the following geographical areas: (1) Moluccas; (2) Kepulauan Kai, Waigeo, New Guinea; (3) Admiralty Islands; (4) Bismarck Archipelago, Solomon Islands.

BIOLOGY. Early stages and host-plants unknown. Moths collected in all months of the year.

DISTRIBUTION (Figs 17–19). Moluccas; Kepulauan Kai; Waigeo; New Guinea; Bismarck Archipelago and Solomon Islands.

***Vitessa hemiallactis moluccana* subsp. n.**

(Figs 17, 94, 95, 156, 190, 247, 293)

[*Vitessa suradeva* Moore; Pagenstecher, 1886 : 167, 188, partim. Misidentification.]

♂, ♀. 42–50 mm. Generally as described for species. Frons in ♂ orange at base with extensive blue-black above, completely orange in ♀. Vertex orange with extensive black scaling admixed. Basal scaling of proboscis blue-black, orange admixed laterally. Thorax posteriorly tipped with white; patagium glossy blue-black, medially edged with orange; tegula glossy blue-black, laterally edged with orange. Fore wing above, orange subbasal area from near costa to A_1 ; narrow antemedial fascia divided at cell, anterior spot minute, triangular, sub-costal, posterior spot large, oblong, medially diffuse; postmedial fascia divided at Cu_2 , anterior spot large, round, over discocellular vein from stem of R to Cu_2 , posterior spot small, triangular and over CuP , terminal margin level with anterior spot; terminal vein-lines extensive, not reaching postmedial fascia. Hind wing above: black terminal band broad, slightly diffuse medially; white medial area narrow, reaching anal margin. Fore wing below: postmedial fascia large, oval or narrowly divided at Cu_2 , apical area with variable number of veins-lines. Hind wing below: apical vein-lines variable.

GENITALIA ♂ (Figs 156, 190). Generally as described for species. Base of valve wide. See Remarks.

GENITALIA ♀ (Figs 247, 293). Generally as described for species. Posterior edge of trapezoidal wall of antrum very broad, anterior development very narrow (Fig. 293).

REMARKS. Although only eight specimens are available they fall outside the range of variation of an extensive series of the nominate subspecies. We conjecture that Pagenstecher's record from Ambon is referable to this species and subspecies. The subspecies is distinguished from the nominate subspecies by the reduced pale markings on the wings. In the ♂ genitalia the valve base is slightly wider than in the nominate subspecies and the valve is slightly longer. In the ♀ genitalia the antrum has the trapezoidal area broader and the anterior development narrower than in any other subspecies.

BIOLOGY. Early stages and host-plant unknown. Holotype collected in September.

DISTRIBUTION (Fig. 17). Moluccas.

MATERIAL EXAMINED

Holotype ♂, *Moluccas*: Obi, Laiwui, ix.1897 (*Doherty*) (genitalia slide no. 14627; BMNH).

Paratypes. *Moluccas*: 1 ♀ (allotype), Halmaheira (*Waterstradt*) (genitalia slide no. 15818; BMNH); 1 ♂, Halmaheira, Toeelo (*Le Moul*) ([abdomen missing] BMNH); 1 ♂, Seram, 1895 (RNH, Leiden); 1 ♂, 1 ♀, Seram (*Piepers*) (RNH, Leiden); 1 ♂, 1 ♀, no data (*Piepers*) (genitalia slide no. 15818/a, Shaffer; RNH, Leiden).

Vitessa hemiallactis subsp.

The following specimen probably represents a distinct subspecies, but without adequate material or data we prefer not to name it.

♀. 56 mm. Specimen in poor condition; in most characters similar to *V. hemiallactis moluccana*. Fore wing above: lower spot of antemedial fascia broadly triangular, larger than in subspecies *moluccana*; postmedial fascia also similar but lower spot more terminally oblique. Hind wing with narrow black margin and extremely wide white medial area, exceeding any other species and subspecies in this group. Genitalia much as in *V. hemiallactis moluccana*; posterior apophyses proportionally longer.

DISTRIBUTION. Unknown.

MATERIAL EXAMINED

1 ♀, no data, Moore coll. (BMNH).

Vitessa hemiallactis hemiallactis Meyrick, 1887
(Figs 18, 29, 96, 97, 157, 191, 213, 248, 294)

[*Vitessa suradeva* Moore; Pagenstecher, 1886 : 167. Misidentification.]

[*Vitessa pyraliata* Walker; Meyrick, 1886 : 213. Misidentification.]

Vitessa hemiallactis Meyrick, 1887, *Trans. ent. Soc. Lond.* 1887 : 193; Ragonot, 1891 : 110; Hampson, 1896b : 503; Swinhoe, 1900 : 429. LECTOTYPE ♂, NEW GUINEA: Papua, 87-50 Port Moresby (*Mathews*) (genitalia slide no. 8257; BMNH), here designated [examined].

[*Vitessa suradeva* Moore; Kenrick, 1907 : 75. Misidentification.]

♂, ♀. 42-56 mm. Generally as described for species. Frons orange at base, with extensive blue-black above in ♂, completely orange in ♀. Vertex orange with extensive blue-black admixed. Basal scaling of proboscis blue-black. Thorax above posteriorly tipped with pale yellow; patagium orange with glossy blue-black posteromedially, blue-black more extensive in ♂ than in ♀; tegula mostly glossy blue-black, laterally edged with orange, with more orange medially in ♀ than in ♂. Fore wing above: orange subbasal area from near costa to A_1 ; broad antemedial fascia widely indented at cell, sometimes finely divided in ♂, medial streaking approaching postmedial fascia; broad postmedial fascia strongly indented at Cu_2 , sometimes divided, anterior part broad and rounded, posterior part triangular, more oblique to termen, streaks extending medially but not reaching antemedial fascia; terminal area with vein-lines more extensive in ♀ than in ♂, not reaching postmedial fascia. Hind wing above: black terminal band narrow, sharply demarcated from white medial area; medial area broad, fine black line at anal margin. Fore wing below; postmedial fascia a large oval; apical area with slightly variable number of vein-lines. Hind wing below: apical vein-lines slightly variable.

GENITALIA ♂ (Figs 29, 157, 191, 213). Generally as described for species. Clasper variable in outline.

GENITALIA ♀ (Figs 248, 294). Generally as described for species. Trapezoidal wall of antrum noticeably broadening anteriorly; anterior development of antrum exceeding medial pouch (Fig. 294).

REMARKS. The white markings on the upperside of the wings are more extensive than in other subspecies. The subspecies differs from more easterly subspecies in the less intense metallic gloss of the upperside markings. In markings it is almost indistinguishable from *V. hollandi hollandi* in the *stettina*-group, with which it flies (see also Remarks under *V. stettina* and *V. hollandi*), but the genitalia differ as indicated in the species-group diagnosis, and in the ♀ the posterior margin of the seventh abdominal sternite is convex, not straight or concave as in *V. hollandi*.

BIOLOGY. Early stages and host-plant unknown. Moths collected in most months of the year. Specimens from Waigeo, Camp Nok, are labelled as being diurnal; in the same series one is labelled as being caught at light.

DISTRIBUTION (Fig. 18). Kepulauan Kai; Waigeo; New Guinea.

MATERIAL EXAMINED

Paralectotype. 1 ♀, data as lectotype (genitalia slide no. 15326; BMNH).

Kepulauan Kai: 1 ♂, 1 ♀, Little Kei ('Kai Ketjil'), iv. (Kühn) (BMNH). **Waigeo:** 1 ♂, 1 ♀ (Waterstradt) (BMNH); 1 ♂ (Wallace) (UM, Oxford); 3 ♂, 3 ♀ [2 ♂, labelled diurnal, 1 ♀, labelled at light], Camp Nok, 750 m, v.1938 (Cheesman) (BMNH). **New Guinea:** 7 ♀, Irian Jaya, Central Arfak Mts, Ninay Valley, 1050–1100 m, xi.1908–i-iii.1909 (A. E. Pratt) (BMNH); CU, Ithaca; 1 ♀, I. J., Arfak Mts, 1200 m, ii–iii.1909 (C. B. Pratt) (CMAG, Birmingham); 1 ♀, I. J., Arfak Mts, 1850 m, iii.1910 (C. B. & F. B. Pratt) (BMNH); 1 ♀, I. J., Dorey, vi.1897 (Doherty) (BMNH); 1 ♀, I. J., Kapaur, xii.1896–i.1897 (Doherty) (BMNH); 3 ♀, I. J., Geelwink [sic] Bay, near Wandesi, 1892 (Doherty) (BMNH); 2 ♂, I. J., Nomnagihe, 40–23 km south of Wangaar, 600 m, i–ii.1921 (C. F. & J. Pratt) (TM, Pretoria); 1 ♀, I. J., Mt Goliath, about 139° Long., 1500 m, iii.1911 (Meek) (BMNH); 1 ♀, I. J., River Tor (mouth), 4 km E. of Hol.[andia], Maffen, vii.1959 (Maa) (BPBM, Honolulu); 2 ♂, I. J., Maffin Bay, x.1944 (Ross) (CAS, San Francisco; CNC, Ottawa); 2 ♀, I. J., Waris, S. of Hollandia, 450–500 m, viii.1959 (Maa) (BPBM, Honolulu); 6 ♀, I. J., Humboldt Bay, ix–x.1892 (Doherty) (BMNH); 1 ♀, I. J., 1939, ex Guedet collection (CAS, San Francisco); 1 ♀, Papua New Guinea, Telefomin (Eliptamin), 1350–1700 m, vi–ix.1959 (Brandt) (ANIC, Canberra); 1 ♂, 6 ♀, P. N. G., Hunstein-Gebirge, Wagu/Black River, ix.1972–iii.1973 (Hohmann) (UM, Bremen); 11 ♀, P. N. G., Sepik R., Padwe, x.1957 (Munroe & Holland) (CNC, Ottawa); 7 ♂, 65 ♀, P. N. G., Sepik District, Bainyik, 300 m, x–xi.1957 (Munroe & Holland) (CNC, Ottawa); 1 ♂, 1 ♀, P. N. G., Koigin, nr Wewak, 350 m, x.1957 (Munroe & Holland) (CNC, Ottawa); 3 ♀, P. N. G., Astrolabe Range, winter, 1917 (F. P. & W. D. Dodd) (BMNH); 3 ♂, 6 ♀, P. N. G., Astrolabe Bay (Wahnes) (BMNH); 13 ♂, 33 ♀, Finisterre Mts, Wantoat, 1200 m, ix.1957 (Munroe & Holland) (CNC, Ottawa); 2 ♀, P. N. G., Western Highlands, Mt Hagen Valley, Keltiga, 1700 m, ix–x.1961 (Brandt) (ANIC, Canberra); 1 ♀, P. N. G., Kainantu, 1650 m, x.1959 (Maa) (BPBM, Honolulu); 1 ♀, P. N. G., west of Lae, Bubia, sea level, viii.1957 (Munroe & Holland) (CNC, Ottawa); 1 ♀, P. N. G., Lae, Botanic Garden, 30 m, viii.1957 (Munroe & Holland) (CNC, Ottawa); 1 ♀, P. N. G., Lae, vi.1951 (Brandt & Hallstrom) (ANIC, Canberra); 2 ♀, P. N. G., Busu River, E. of Lae, 0–60 m, viii.1957 (Munroe & Holland) (CNC, Ottawa); 1 ♀, P. N. G., 8–04 km north-east of Lae, 30 m, viii.1957 (Munroe & Holland) (CNC, Ottawa); 1 ♀, P. N. G., south side of Markham Valley, Oomsis, 0–30 m, viii.1957 (Munroe & Holland) (CNC, Ottawa); 12 ♂, 7 ♀, P. N. G., Morobe District, Bulolo, *Araucaria* forest, 1200 m, ix.1957 (Munroe & Holland) (CNC, Ottawa); 1 ♀, P. N. G., Fly River, Kiunga, vii–x.1957 (Brandt) (ANIC, Canberra); 1 ♀, P. N. G., Omati, iii.1952 (Barnett) (BMNH); 10 ♂, 9 ♀, P. N. G., Mount Kebea, 1100 m, vii–viii.1903 (A. E. Pratt) (BMNH); CMAG, Birmingham); 1 ♀, P. N. G., Ekeikei, 450 m, iii–iv.1903 (A. E. Pratt) (BMNH); 1 ♀, P. N. G., Aroa River (Meek) (BMNH); 1 ♂, 1 ♀, P. N. G., Lower Aroa R., xi.1904–iii.1905 (Meek) (BMNH); 4 ♂, 3 ♀, P. N. G., Port Moresby, Mt Lawes, 400 m, iii–v.1963 (Brandt) (ANIC, Canberra); 1 ♀, P. N. G., Central District, Brown R., Karema, sea level, viii.1957 (Munroe & Holland) (CNC, Ottawa); 1 ♀, P. N. G., Bisianumu, NE. of Port Moresby, 150 m, vi.1957 (Hardy) (BPBM, Honolulu); 10 ♂, 18 ♀, P. N. G., Sogeri Plateau, Bisianumu, 500 m, viii.1957 (Munroe & Holland) (CNC, Ottawa); 59 ♂, 96 ♀, P. N. G., Sogeri Plateau, Mageri, 500 m, viii.1957 (Munroe & Holland) (CNC, Ottawa); 6 ♀, P. N. G., Lejo, 15 km WNW – Popondetta, v.1973 (Hohmann) (UM, Bremen); 1 ♂, 3 ♀, P. N. G., Hydrographer Mts, 750 m, i–iii.1918 (Eichhorn Bros.) (BMNH); 1 ♀, P. N. G., Biagi, Mambare R., 1500 m, iii.1906 (Meek) (BMNH); 1 ♀, P. N. G., Amazon Bay area, Dogon, 700 m, ix–xii.1962 (Brandt) (ANIC, Canberra); 4 ♀, P. N. G., Milne Bay, xi.1898–ii.1899 (Meek) (BMNH); 1 ♀, no data, 600 m (Barnett) (BMNH); 1 ♀, no data (Walsh) (RNH, Leiden).

The following data are dubious. **Bismarck Archipelago:** 1 ♂, New Britain, Rabaul District (Verteuil) (BMNH).

Vitessa hemiallactis admiralitatis subsp. n.

(Figs 19, 37, 98, 99, 158, 192, 249, 295)

♂, ♀. 40–50 mm. Generally as described for species. Frons and vertex orange. Basal scaling of proboscis glossy blue-black. Thorax above: glossy blue-black, posteriorly white-tipped; patagium glossy blue-black, lateral extremities orange; tegula glossy blue-black. Abdomen above: glossy black; grey terminal lines on segments much reduced or absent; terminal segment with orange posterior margin. Fore wing above: ground colour glossy blue-black, basal areas and posterior margin with greenish hue; orange subbasal area small, in ♀ short of costa, reaching to A_1 , in ♂ restricted to smaller dot posterior to base of cell; white antemedial fascia very narrow, basally straight, medially diffuse and indented at cell, short of costa and posterior margin; white postmedial fascia oblique, narrowly divided at Cu_2 , round anterior spot

slightly larger than triangular posterior spot; terminal area with vein-lines short and restricted, not reaching termen or postmedial fascia, more extensive in ♀. Hind wing above: small black basal area, well demarcated terminal black band, anal margin narrowly black, angled from basal area. Wings below with faint, much reduced apical vein-lines.

GENITALIA ♂ (Figs 37, 158, 192). As described for species.

GENITALIA ♀ (Figs 249, 295). Generally as described for species. Posterior trapezoidal wall of antrum with lateral margins posteromedially oblique, posterior margin concave; long anterior development of antrum (Fig. 295).

REMARKS. This subspecies more closely resembles *V. hemiallactis lustrans* than the nominate subspecies, but differs from *V. h. lustrans* in the less extensive orange markings of the thorax, wing base and subbasal area, the very narrow but generally undivided antemedial fascia of the fore wing and the more extensive development of the terminal white vein-lines. It differs from the nominate subspecies in having the frons and vertex wholly orange, in the less extensive pale markings on the fore wing, and the thicker black terminal band on the hind wing. In the ♂ genitalia the clasper is more irregular in outline than in previous subspecies; in the ♀ genitalia the shape of the antrum is different.

BIOLOGY. Early stages and host-plant unknown. Moths collected in April, June, September and October.

DISTRIBUTION (Fig. 19). Admiralty Islands.

MATERIAL EXAMINED

Holotype ♂, **Admiralty Islands**: Manus, ix-x.1913 (*Meek*) (BMNH).

Paratypes. **Admiralty Islands**: 2 ♂, 4 ♀ (including allotype), data as holotype (genitalia slide no.'s 15140, 15819; BMNH); 1 ♂, 6 ♀ [no exact data] (*Meek*) (genitalia slide no.'s 14658, 14659, 15820; BMNH); 1 ♀, Manus I., Rossum, 35-125 m, vi.1959 (*Gressitt*) (BPBM, Honolulu); 1 ♂, Los Negros I., iv.1952, (*Brandt & Hallstrom*) (ANIC, Canberra).

Vitessa hemiallactis lustrans subsp. n.

(Figs 19, 100, 101, 159, 193, 250, 296)

[*Vitessa ternatica* Lederer; Pagenstecher, 1900 : 169. Misidentification.]

♂, ♀, 42-54 mm. Generally as described for species and previous subspecies. Frons and vertex dark orange sometimes lightly admixed with black in ♂. Patagium medially glossy blue-black, laterally dark orange, with medial streak of orange in ♀; tegula glossy blue-black, small orange spot anteromedially, larger orange spot on outer margin. Abdomen above glossy black, terminal segment with orange posterior margin. Fore wing above: orange subbasal area large, slightly short of costa, anteriorly extending beyond A_1 , of similar size in both sexes; white antemedial fascia narrow, broadly divided, anterior spot minute, subcostal; posterior spot broadly triangular, extending from cell to beyond A_1 ; white postmedial fascia oblique, broadly divided at Cu_2 , round anterior spot larger than triangular posterior spot; terminal area with vein-lines larger and more extensive in ♀ than in ♂, longest on R_5 and M_1 , much restricted in ♂, not reaching termen or postmedial fascia. Hind wing above, black band on terminal margin very wide. Wings below with faint, much reduced apical vein-lines, sometimes absent on hind wing in both sexes.

GENITALIA ♂ (Figs 159, 193). Generally as described for species. Clasper with free margin deeply concave at centre, basally with high acuminate ridge.

GENITALIA ♀ (Figs 250, 296). Generally as described for species. Posterior trapezoidal wall of antrum with posterior margin slightly convex (Fig. 296).

REMARKS. This subspecies most closely resembles *V. hemiallactis admiralitatis*; it differs in the ♂ genitalia by the shape of the clasper and in the ♀ by the shape of the posterior wall of the antrum. There is little variation within the Bismarck Archipelago. A specimen from the Rabaul District of New Britain is unlike all others from this area and exactly matches the New Guinea subspecies to which we have referred it; the specimen may be mislabelled or it may represent an accidentally introduced New Guinea individual. We have not seen Pagenstecher's material, collected by Ribbe in New Britain (Neu Pommern), Kinigunang, but it almost certainly belongs to this species

and subspecies. It is possible that the bulk of the Solomon Islands specimens represent a distinct subspecies. The fore wing markings are slightly different from the more northerly material but are also variable over the Solomon Islands range. In the ♂ genitalia the valve is narrower and longer; in an isolated specimen from Florida Island the right cornuti cluster is much reduced, though this may be due to broken-off spines. A description and naming will await the discovery of more ♂ specimens from a range of the islands.

BIOLOGY. Early stages and host-plant unknown. Moths collected in most months of the year.

DISTRIBUTION (Fig. 19). Bismarck Archipelago; Solomon Islands.

MATERIAL EXAMINED

Holotype ♂, **Bismarck Archipelago**: New Hannover, iii.1923 (*Meek*) (BMNH).

Paratypes. **Bismarck Archipelago**: 1 ♀ (allotype), New Hannover, iv.1923 (*Meek*) (BMNH); 5 ♂, 2 ♀, New Hannover, ii–iii.1923 (*Meek*) (genitalia slide no.'s 14660, 14661, 15822, 15825; BMNH).

Material excluded from paratype series. **Bismarck Archipelago**: 1 ♂, 4 ♀, Rooke I. ('Umboi Island'), vii–viii.1913 (*Meek*) (BMNH); 2 ♂, 12 ♀, New Ireland, xi.1923–ii.1924 (*A. F. Eichhorn*) (BMNH; CMAG, Birmingham; TM, Pretoria); 4 ♀, New Britain (*Wahnes*) (BMNH); 3 ♀, New Britain, Talesea, i–iv.1925 (*A. F. Eichhorn*) (BMNH); 1 ♀, New Britain, Keravat, 135 m, xi.1959, at mercury vapour light (*Maa*) (BPBM, Honolulu); 1 ♀, New Britain, Yalom, 1000 m, v.1962 (ZM, Copenhagen); 2 ♀, New Britain, Mt Sinewit, 1050 m, vi–ix.1963 (*Brandt*) (ANIC, Canberra; CNC, Ottawa). [1 ♂, New Britain; see Remarks.] **Solomon Islands**: 2 ♀, Bougainville, Buin, Kukugai Village, x.1960–ii.1961 (*Brandt*) (ANIC, Canberra; CNC, Ottawa); 8 ♂, 9 ♀, Guizo ('Gizo Island'), xi.1903 (*Meek*) (BMNH; CNC, Ottawa; NMNH, Washington); 1 ♂, Florida, i.1901 (*Meek*) (BMNH); 1 ♀, Guadalcanal, Betikama R., viii–x.1960 (*Brandt*) (ANIC, Canberra).

Vitessa intermedia sp. n.

(Figs 20, 102, 103, 160, 194, 251, 297)

♂, ♀. 50–60 mm. Frons and vertex orange, admixed with black in ♂; scaling of vertex forming strong crest. Eye brownish fuscous. Ocellus minute, brown. Chaetosema with pale yellowish setae. Antenna black, anterior surface of scape basally orange; posterior surface with basal half of apical third of shaft white. Labial palpus: first segment orange; second segment orange, distally black; third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis black, sometimes laterally admixed with orange. Neck region orange. Thorax above: anteriorly orange, medially blue-black, posteriorly white admixed with yellow; patagium orange with posteromedial glossy blue-black spot; tegula orange with anterolateral glossy blue-black spot and posteriorly admixed with black. Abdomen above matt black, posterior margins of segments whitish grey, posterior half of terminal segment and anal tuft orange. Body below blue-black with oblique white bands; pectus orange; whitish grey abdominal lines broader than above, posterior half of terminal segment and anal tuft orange. Legs blue-black; greenish hue on fore coxa; white on ventral surfaces of femora; medial white band on mid tibia; white at tips of tibiae and ventral surfaces of tibial spurs. Fore wing above: orange subbasal area large with narrow subcostal streak to base, basal blue-black spot partially demarcated, orange short of costa and posterior margin; glossy blue-black subbasal fascia with greenish hue; whitish grey transverse fasciae with pale greenish hue, antemedial and postmedial fasciae wide, medially diffuse, irregularly joining, usually both fasciae slightly short of costa and posterior margin; medial blue-black fascia reduced to two irregularly shaped patches, or, more rarely, a single longitudinally triangular spot on cell; terminal area wide, greenish white vein lines thick on all veins, most lines joining postmedial fascia and termen, completely merging in costal region; fringe dark grey. Hind wing above: broad black terminal band violaceous, gradually tapering from costa, acuminate at anal margin, close to infuscation from wing base, anal margin edged with black; white medial area large, oval; fringe dark grey, distally white near apex. Fore wing below: black, weakly violaceous; retinaculum light grey; a single large, oval postmedial fascia, in ♂ extending to near posterior margin, in ♀ hardly passing Cu_2 ; terminal area with apical white vein-lines, posteriorly shorter and weaker; posterior margin white; fringe as above. Hind wing below: much as above, long white vein-lines near costa and apex, small vein-lines on posterior part of termen; fringe as above.

GENITALIA ♂ (Figs 160, 194). As described for *V. hemiallactis*, but see Remarks.

GENITALIA ♀ (Figs 251, 297). As described for *V. hemiallactis*, but see Remarks.

REMARKS. This species is externally almost identical with the sympatric *V. stettina*, which also has very broad white fasciae on the fore wing, but differs by having the fasciae converging on the

medial area and fusing; its genitalia are very distinct. *V. intermedia* flies over the same range of altitudes as *V. stettina*, though it appears to be more common in the upper part of its range than in the lower, where it is largely replaced by *V. hemiallactis*. The paratype series includes ♂ and ♀ paralectotypes of *V. stettina*, from which Swinhoe failed to distinguish the present species. *V. intermedia* closely resembles the Australian *V. glaucoptera* in appearance and general structure; one ♂ from Avola, Papua, has wing markings almost identical with those of *V. glaucoptera*, but represents an extreme of variation. *V. intermedia* differs from *V. barretti*, which overlaps the upper part of its altitude range, by the smaller size, smaller orange subbasal area, less completely fused fasciae, thinner vein-lines, merging only slightly in the costal region; in the ♂ genitalia the posteroventral angle of the valve is less extended; in the ♀ genitalia the posterior development of the trapezoidal wall of the antrum is longer but narrower (Fig. 297). *V. intermedia* closely resembles *V. hemiallactis hemiallactis* but has larger wing markings; the ♂ genitalia have a larger valve and a more extended posteroventral angle; the ♀ genitalia most closely resemble those of *V. hemiallactis lustrans*. In external and genital characters this species is intermediate between *V. hemiallactis* and *V. barretti* and, apart from the latter species, is the largest species in the *hemiallactis*-group.

BIOLOGY. Early stages and host-plant unknown. Moths collected in February, March, June and August.

DISTRIBUTION (Fig. 20). New Guinea: Papua New Guinea.

MATERIAL EXAMINED

Holotype ♂, **New Guinea:** Papua, Biagi, Mambare R[iver], 1500 m ('5000 ft'), ii.1906 (*Meek*) (genitalia slide no. 15311; BMNH).

Paratypes. **New Guinea:** 1 ♀ (allotype), Papua New Guinea, data as holotype, iii.1906 (genitalia slide no. 15347; BMNH); 1 ♂, P. N. G., Granville ('Port Moresby') [paralectotype of *Vitessa stettina* Swinhoe] (genitalia slide no. 8259; BMNH); 1 ♂, P. N. G., Granville, 6845 (genitalia slide no. 15309; BMNH); 1 ♂, P. N. G., Milne Bay, 20.viii.1903 (*Meek*) (genitalia slide no. 15340; BMNH); 1 ♀, P. N. G., Mount Kebea, 1100 m ('3600 ft'), vi.1903 (*A. E. Pratt*) [paralectotype of *Vitessa stettina* Swinhoe] (genitalia slide no. 15346; BMNH); 1 ♀, P. N. G., Foula, 1350 m ('4500 ft'), viii.1903 (*A. E. Pratt*) (genitalia slide no. 15348; BMNH); 8 ♂, 1 ♀, P. N. G., Avola, 1850 m ('6000 ft'), viii.1903 (*A. E. Pratt*) (genitalia slide no.'s 14718, 15310, 15313, 15316, 15319, 15339, 15341 [1 ♂, 1 ♀, abdomens missing]; BMNH).

Vitessa barretti sp. n.

(Figs 20, 104, 105, 161, 252, 298)

♂, ♀. 58–63 mm. Frons and vertex unusually narrow, orange. Eye and ocellus fuscous. Chaetosema with pale yellowish setae. Antenna black; dorsal scaling on basal half of apical third of shaft white. Labial palpus mainly black with considerable orange admixture dorsolaterally and ventrally. Maxillary palpus basally black, distally orange. Basal scaling of proboscis black. Neck region orange. Thorax above black, anteriorly orange; patagium orange with large medial glossy blue-black spot; tegula orange with antero-lateral glossy blue-black spot. Abdomen above black, posterior margins of segments narrowly white; anal tuft orange. Body below black, abdomen as above; thorax and legs black with extremely restricted areas of white. Fore wing rather wide; above: orange subbasal area large, reaching posterior margin; narrow subcostal streak to base, partially demarcating basal blue-black spot; very narrow glossy blue-black subbasal fascia; antemedial and postmedial greyish green fasciae completely fused, reaching costa and posterior margin, medial fascia a small, longitudinal, triangular, blue-black streak in cell; thick greyish green vein-lines in terminal area, all merging with postmedial fascia, especially at costa, blue-black streaks between lines; fringe basally black, distally pale grey. Hind wing above: broad black terminal band violaceous, inner margin angled from M_1 to Cu_2 , abruptly narrowing then tapering to anal margin; deep infuscation from base; white medial area oval, reaching anal margin; fringe basally fuscous, distally white. Fore wing below: black; single, small, irregularly ovate, white postmedial fascia in ♂ with diffuse white distally in cubital area; subterminal whitish grey vein-lines; fringe basally blackish fuscous, distally paler. Hind wing below: like upperside; white vein-lines apically and terminally.

GENITALIA ♂ (Fig. 161). Generally as described for *V. hemiallactis*. Large valve distally subtruncate; termen narrowly rounded; base of uncus fairly wide.

GENITALIA ♀ (Figs 252, 298). As described for *V. hemiallactis*.

REMARKS. This species resembles *V. griseata* in the almost unicolorous medial area of the fore wing, but is distinguished by the black medial streak on the fore wing and the white medial area on the hind wing, as well as by genitalia (see diagnoses of the *griseata*- and *hemiallactis*-groups). This species is distinguished from *V. stettina* by the loss of much of the black pattern of the fore wing, and by the group characters of the genitalia; it shows similar pattern differences from *V. intermedia* and also has the orange subbasal area larger; the ♂ genitalia, though almost identical with those of *V. intermedia*, have the posteroventral angle of the valve more extended; in the ♀ genitalia the posterior development of the trapezoidal wall of the antrum is shorter but broader (Fig. 298). This species, however, is most easily confused with *V. glaucoptera* from Australia, which has almost identical wing markings and genitalia; it is distinguished by the much larger size and by having the black streak between M_1 and M_2 of the fore wing more constricted at junction with fasciae and the black streak in the cell longer; the genitalia are correspondingly larger. Though the members of the *hemiallactis*-complex in New Guinea and Australia are closely related to one another, it seems best at present to consider *V. hemiallactis*, *intermedia*, *barretti* and *glaucoptera* different species. We take pleasure in dedicating the present species to Mr J. Barrett, collector of the holotype.

BIOLOGY. Early stages and host-plant unknown. Moths collected in February and September, at altitudes from 600 to over 1800 m.

DISTRIBUTION (Fig. 20). New Guinea: Papua New Guinea, in the central mountains.

MATERIAL EXAMINED

Holotype ♂, **New Guinea:** North-east New Guinea, Western Highlands, Mt Hagen, 22.ix.1951 (*Barrett*) (genitalia slide no. DK 78; CNC, Ottawa).

Paratypes. **New Guinea:** 1 ♀ (allotype), Papua New Guinea, Eastern Highlands, Aiyura, 27.ix.1957 (*Munroe & Holland*) (genitalia slide no. DK 79; CNC, Ottawa); P. N. G., 1 ♀, Gurukor, 600 m, 10–12.ii.1978 (*Hébert*) (CNC, Ottawa).

Vitessa glaucoptera Hampson, 1906 (Figs 20, 106, 107, 162, 195, 253, 299)

Vitessa glaucoptera Hampson, 1906, *Ann. Mag. nat. Hist.* (7) **17** : 216. Holotype ♂, AUSTRALIA: Queensland, Cedar Bay, s[outh] of Cooktown (*Meek*) (genitalia slide no. 8258; BMNH) [examined].

♂, ♀. 34–52 mm. [Holotype 46 mm, incorrectly given by Hampson as 30 mm.] Frons orange; vertex orange admixed with dark grey. Eye and ocellus brown. Chaetosema with pale yellowish setae. Antenna black; base of scape orange; dorsal scaling of basal half of apical third of shaft white. Labial palpus: first two segments orange, third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis black, laterally orange, orange admixed dorsally. Neck region orange. Thorax above orange, with large central blue-black spot; patagium orange with small posteromedial glossy blue-black spot; tegula orange, distally admixed with black, small anterolateral glossy blue-black spot. Abdomen above: matt black, posterior margins of segments narrowly white, terminal segment with posterior margin and anal tuft orange. Body below blue-black; pectus orange; legs blue-black with dark green hue; white bands on mid and hind coxae; white on ventral surfaces of mid and hind femora; medial white band on mid tibia; tibiae white-tipped; tibial spurs dorsally white; abdomen with white margins broader than above. Fore wing above: orange subbasal area large, with narrow subcostal streak to base; basal blue-black spot partially demarcated; orange sometimes reaching posterior margin in ♀; narrow glossy blue-black subbasal fascia; greyish green antemedial and postmedial fasciae almost completely fused, reaching costa and posterior margin, small broadly triangular blue-black spot in cell, sometimes with small black subcostal streak above and diffuse black patch below in cubital area; thin greyish green vein-lines in terminal area, on M_1 and M_2 slightly short of fasciae, sometimes also on *CuP*; fringe basally dark grey, distally light grey. Hind wing above: broad black terminal band violaceous, broad at apex, basal margin angled from M_1 to Cu_2 , abruptly narrowing and tapering to anal margin; fringe basally dark grey, distally white. Fore wing below: black; single, small, irregularly ovate, white postmedial fascia, diffuse in cubital region; scattered white scales along costa; posterior margin white; fine, small, white apical vein-lines; fringe as above. Hind wing below as above; small, faint, white apical vein-lines.

GENITALIA ♂ (Figs 162, 195). Generally as described for *V. hemiallactis*. Posteroventral angle of valve broadly rounded, valve narrow.

GENITALIA ♀ (Figs 253, 299). As described for *V. hemiallactis*.

REMARKS. In general as in Remarks for *V. barretti*. The greenish colour of the fore wing led Swinhoe to associate *V. stettina* with the present species, but the two are not closely related. The independent acquisition of the same colour by the Australian *V. zemire nephritica* suggests adaptation to a common environmental factor, and can be compared to the parallel acquisition of a similar greenish colour by *V. barretti* and the unrelated *V. griseata* in the highlands of New Guinea. Though externally *V. glaucoptera* most closely resembles *V. barretti*, in size and fore wing markings it is also comparable to *V. intermedia* (see Remarks under *V. intermedia* for Avola specimen). The ♂ genitalia lack the extended posteroventral angle of the valve seen in *V. intermedia* and *barretti*; the valve is most like that of *V. hemiallactis hemiallactis* but narrower; the ♀ genitalia are also most like those of that subspecies.

BIOLOGY. Early stages and host-plant unknown. Moths collected in March, September, November and December.

DISTRIBUTION (Fig. 20). Australia: Queensland.

MATERIAL EXAMINED

Australia: 1 ♀, Queensland, Cedar Bay, south of Cooktown (*Meek*) (BMNH); 1 ♀, Q., Evelyn Scrub [145°27' E, 17°30' S], xi.1910 (*Dodd*) (ANIC, Canberra); 3 ♂, 1 ♀, Q., Kuranda, iii, ix, xii.1904, iv.1905 (*Dodd*) (ANIC, Canberra); 1 ♂, 7 ♀, Q., Kuranda, n. Cairns 1910 (*Dodd*) (BMNH); 2 ♂, 13 ♀, Q., 17.6 km south of Ravenshoe, 800 m, iii.1964 (*Common & Upton*) (ANIC, Canberra; CNC, Ottawa); 2 ♂, 7 ♀, Q., Mt Lewis, 12.8 km north-west of Mt Molloy, 800 m, iii.1964 (*Common & Upton*) (ANIC, Canberra); 3 ♂, 2 ♀, Q., 4.8 km west of Mossman, iii.1964 (*Common & Upton*) (ANIC, Canberra); 1 ♀, Q., 27 km ('17 mls') south of Atherton, 915 m, iii.1964 (*Common & Upton*) (ANIC, Canberra).

Vitessa cristobalensis sp. n.

(Figs 2, 108, 254, 300)

♂. Unknown.

♀. 38 mm. Frons orange. Vertex orange with central admixture of black. Eye and ocellus black. Chaetosema with pale yellowish setae. Antennae black, base of scape orange; dorsal scaling of basal half of apical third of shaft white. Labial palpus: first two segments orange, third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis glossy blue-black. Neck region orange. Thorax above: glossy blue-black, laterally edged and posteriorly tipped with orange; patagium glossy blue-black, laterally tipped with orange; tegula glossy blue-black with anteromedial and outer lateral edges finely orange. Abdomen above black (markings not recorded). Body below blue-black; pectus orange; legs black, mid and hind coxae banded with white, posterior surfaces of mid and hind femora white, mid tibia with medial white band, mid and hind tibiae tipped with white. Fore wing narrow; above: ground colour glossy blue-black with dark green hue; orange subbasal area small, restricted between stem of *R* and *CuP*; faintly greenish white antemedial fascia narrow, deeply indented medially at cell by wedge of ground colour, anterior portion triangular, posterior part oblong and larger, narrowly separated from costa and posterior margin; greenish white postmedial fascia divided into two spots, large oval anterior spot over discocellular vein, extending from stem of *R* to *Cu₂*, posterior spot far distad of anterior, narrowly triangular, spanning *CuP*; terminal area with narrow greenish white vein-lines extending from termen, well short of oval spot of postmedial fascia, but nearly touching posterior triangular spot; fringe glossy, basally dark grey, distally pale grey. Hind wing above: broad blue-black terminal band violaceous, very broad from infuscated costa, commencing from upper end of cell, sharply angled to just beyond *Cu₂*, continuing narrowly and parallel to margin, finely upturned and ending at anal margin; anal margin finely edged with black; white medial area roughly rectangular; fringe basally dark grey, distally white, anal angle black. Fore wing below: blue-black, weakly violaceous, shading to brownish grey and admixed with white at posterior margin; retinaculum light grey; postmedial fascia diffuse, oblique, narrowly oval, white; white vein-lines in terminal area weak and shorter than above; fringe dark grey. Hind wing below as above, fringe mostly white; weak, short apical and terminal vein-lines extending to *Cu₂*, joining fringe.

GENITALIA ♀ (Figs 254, 300). High, dorsally fused, posteriorly narrow and produced ovipositor lobes; surface densely setose, larger setae on margin, spiny setae easily visible at $\times 100$ magnification. Posterior apophysis short, slightly curved. Anterior apophysis longer, thicker, inwardly curved at tip. Posterior ostial sclerite (Fig. 300) very wide with long lateral prolongations anteriorly directed, medial portion

narrow with anterior margin recurved, thickened, forming broad short flap; posterior margin broadly concave; anterior sclerite very wide, short, with recurved and slightly wrinkled ventral margin, minutely denticulate, bearing small weakly developed medial pouch; very broad trapezoidal wall of antrum extending posteriorly between lateral prolongations of posterior sclerite, laterally acutely angled, posterior edge half width of anterior sclerite, antrum anteriorly produced for shorter distance and narrowing; base of ductus seminalis mostly free of sclerotization; ductus bursae slightly expanded posteriorly, remainder of ductus narrow, minutely spinose; corpus bursae comma-shaped, bearing small, paired, denticulate areas.

REMARKS. This is distinguished from all other species and subspecies with narrow, wholly or partly divided white fascia by having the antemedial fascia almost and the postmedial fascia clearly divided into two spots, in combination with the following characters: terminal area with all veins bearing long white vein-lines, nearly touching posterior spot of postmedial fascia; much reduced orange subbasal area. This species most closely resembles *V. hemiallactis lustrans*, but is distinguished by longer vein-lines of the fore wing, the greater width of the antrum and the shape of the corpus bursae.

BIOLOGY. Early stages and host-plant unknown. Holotype collected at black light.

DISTRIBUTION (Fig. 2). Solomon Islands: San Cristobal Island.

MATERIAL EXAMINED

Holotype ♀, **Solomon Islands**: San Cristobal, Warahito-Pogato confluence, 1965, at black light (genitalia slide no. 14263; BMNH).

The pyraliata-group

DIAGNOSIS. Pectinations of ♂ antennae larger than in other species-groups. Wing markings similar to those of *stettina*- and *hemiallactis*-groups, but with pale markings of fore wing relatively restricted in most species. Hind wing markings very varied, in *V. nicobarica* ♂ all dark markings absent, in ♀ white area heavily infuscated; in *V. pyraliata* similar infuscation, but in some subspecies with a very wide terminal band, well demarcated from the white medial area, as also in *V. kolakalis* and *V. sulaensis*; in *V. muluana*, *V. gemina* and *V. splendida* the terminal band narrow, as in *plumosa*- and *suradeva*-groups. ♂ genitalia with basal portion of uncus wide, distal portion rod-like, down-turned then up-curved, with laterally directed setae. Valve of moderate width, shape somewhat similar to that of *hemiallactis*-group, but narrower, clasper coarsely serrated basally and with tooth-like ridges on posterior margin, not finely serrulate as in *hemiallactis*-group. ♀ genitalia with very large ostial chamber; posterior sclerite wide, medial section narrowed but with produced medial or lateral portions; lateral section of sclerite anteriorly elongated, in *V. muluana* with an oblique raised ridge. Anterior sclerite broad, ventrally narrow, antrum very well-developed anteriorly, posterior development similar to that of *hemiallactis*-group. Ostial sclerotization relatively larger than in *stettina*- or *hemiallactis*-groups, smaller and less regular than in *suradeva*-group. Corpus bursae with either fine paired denticulate areas or heavily sclerotized, depressed, paired denticulate signa.

REMARKS. Four of the species assigned to this group are known only from the ♀. When the ♂ characters are known some of these species may require reassignment or the definition of the species-group may have to be revised.

Vitessa nicobarica Hampson, 1896

(Figs 21, 44, 109, 110, 163, 214, 255, 301)

Vitessa nicobarica Hampson, 1896a, *The Fauna of British India, including Ceylon and Burma*. Moths 4 : 146. LECTOTYPE ♂, NICOBAR ISLANDS: Nancowry, Moore coll. 94-106 (genitalia slide no. 8268; BMNH), here designated [examined].

Vitessa nicobarica Hampson; Hampson, 1896b : 503.

♂, ♀. 44 mm (all specimens damaged). Frons, vertex (from remaining scales) orange. Eye, ocellus black. Chaetosema with pale yellowish setae. Antenna black, base of scape orange (at least in ♀; terminal segments lost). Labial palpus blue-black; base of first segment orange; tip of third segment fuscous. Maxillary palpus basally black, distally orange. Basal scaling of proboscis black. Neck region orange. Thorax above: orange with large central blue-black spot; patagium blue-black laterally tipped with orange; tegula orange, with broad, oblique, blue-black band. Abdomen above: ochreous buff, anal tuft orange.

Body below: pectus orange; thorax blue-black; legs black, possibly with some white on coxae (legs mostly damaged or missing); abdomen blackish fuscous, posterior margins of segments whitish buff, pale bands progressively wider on the posterior segments, anal tuft orange. Fore wing narrow, costa convex; above (very worn): ground colour blue-black; orange subbasal area more restricted in ♂, short of costa, reaching to A_1 , in ♀ extending past A_1 , subcostal streak to base partially demarcating blue-black basal spot; narrow white antemedial fascia divided into two spots at cell, smaller triangular anterior spot, larger, rectangular, medially diffuse posterior spot, short of posterior margin, fascia more restricted in ♂; broader white postmedial fascia, divided into two primary spots, anterior spot over discocellular vein, entire, large, oval, short of costa, posterior spot more distal, triangular, divided into four smaller short streaks by black lines on veins Cu_1 , Cu_2 and A_1 , reaching posterior margin in ♀, in some specimens a trace of an additional black line on CuP ; posterior white marking absent in ♂; terminal area with short, thin apical and terminal white vein-lines, short of termen and postmedial fascia, extending to Cu_2 in ♀, very much weaker in ♂; fringe dark grey. Hind wing above: in ♂ uniformly pale yellow with isolated black scales at apex, in ♀ costa black narrowly edged with white, termen black, narrow, diffuse, more strongly black for short distances on M_3 , Cu_1 and Cu_2 , medial area broadly white to anal margin; fringe white, basally admixed with black towards apex. Fore wing below: in ♂, costa narrowly black, apex and termen triangularly black to tornus, slight black admixture from base weakly spreading over cell; remainder of wing and retinaculum pale yellow; fringe black slightly admixed with yellow at tornus; in ♀ white postmedial fascia visible as a broad L-shape broken by black vein-lines as above, fascia very diffuse, posterior margin and retinaculum light grey, remainder of wing black, weakly violaceous. Hind wing below: in ♂ mainly pale yellow with black at base along veins, large black apical patch weakly extended down part of termen, costa and fringe pale yellow; in ♀ exactly like upperside but weakly violaceous.

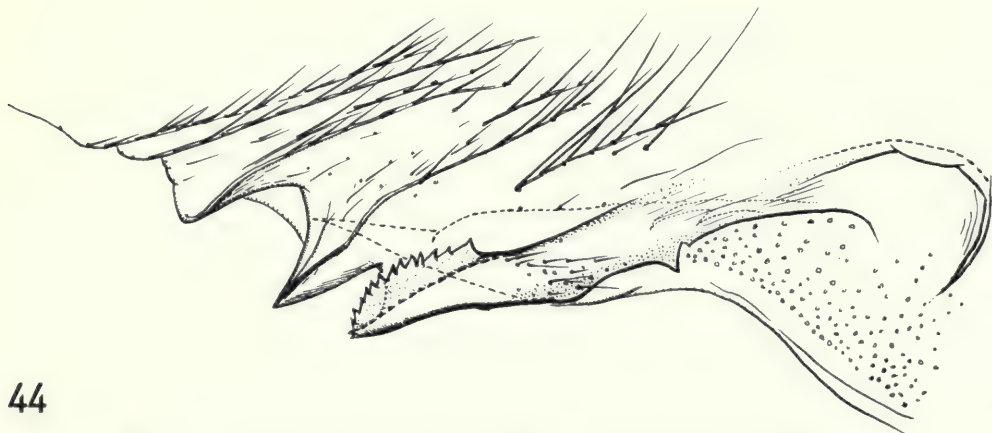


Fig. 44 ♂ genitalia. Detail of left clasper. *Vitessa nicobarica* Hampson.

GENITALIA ♂ (Figs 44, 163, 214). Uncus slender, basal portion flattened, laterally constricted, foramen posteriorly acuminate, terminal portion narrow, decurved then up-turned with sparse, long, laterally directed setae, tip broadly pointed. Gnathos with widely arched lateral arms and compressed, relatively short, talon-shaped medial process, tip finely acuminate. Transtilla broadly arcuate, medially widened. Tegumen with posterior sclerite broad and rounded, anterior sclerite widely emarginated medially. Vinculum broad, anteriorly slightly concave. Valve narrow, costa narrowly inflated, apex acutely rounded, distal margin weakly excised below middle, mesal surface with fine oblique converging striations; clasper (Fig. 44) a long diagonal ridge with basal curved carina, base of ridge edged with a few points, continuing to form three tooth-like, medially ridged processes, diminishing in size towards distal margin of valve, smaller ridges merging with mesal striations; largest process bearing raised serrulate ridge. Juxta with large narrow lateral sclerites, ventral process long, flat, narrow, up-turned, supporting base of anellus, dorsal process shorter, broader, bearing setae, connected directly to sclerotized longitudinally ridged narrow plates supporting sides of anellus; between sclerites and connected medially, a catena divided into two large, narrow, heavily sclerotized ridges, distally spined and medially separated, basally rounded, connected by a lightly sclerotized wrinkled element (area damaged); manica supported by lightly sclerotized bands (anellus not everted in slide preparations). Aedeagus long, distally expanded, base narrowly rounded; ductus ejaculatorius subbasal; vesica with spines spreading ventrally to distal end of

aedeagus, here membrane bulbous and transversely rugose; between cornuti clusters vesica longitudinally rugose and sclerotized at point of reflexion, probably making an elbow-shaped angle (vesica not properly everted in slide preparations); cornuti (Fig. 214) in three clusters, two proximal dorsolateral clusters of same size bearing large spines, one distal ventrolateral cluster bearing smaller spines.

GENITALIA ♀ (Figs 255, 301). High, posteriorly narrow and produced ovipositor lobes, dorsally fused; surface densely setose, larger setae on margin, spiny setae easily visible at $\times 100$ magnification. Apophyses fairly short, slender, weakly curved; anterior apophysis longer and thicker than posterior apophysis. Posterior ostial sclerite (Fig. 301) wide with short lateral prolongations anteriorly directed, medial portion prolonged with short constricted base, posterior margin rounded and medially emarginate; anterior sclerite wide with ventral margin short, recurved, slightly wrinkled and laterally denticulate; very long dorsal wall of antrum extending with curved margin to base of medial prolongation of posterior sclerite, anteriorly protruded and funnel-shaped; ductus seminalis arising at junction of antrum with swollen base of ductus bursae, remainder of ductus bursae narrow, anteriorly spinose; corpus bursae oval, bearing minute paired denticulate areas.

REMARKS. Despite the unusual lithosiid-like external appearance of this species, it is close in genital structure to *V. pyraliata*. It is distinguished by the rounded costa of the fore wing and in the ♂ by the yellow hind wing devoid of a dark terminal band; also on the underside of the hind wing by the black triangular apical marking; the ♀ hind wing is more typical, but has a large white medial area and diffuse black markings. The ♂ genitalia are distinguished by the smaller talon-shaped gnathos, the narrower valve and the arrangement of ridges and points on clasper, with very distinctive serrulate ridge on basal process; the divided catena is unique; in the ♀ genitalia the shape of the sclerites in the ostial chamber is distinctive.

BIOLOGY. Early stages, host-plant, and season of flight unknown.

DISTRIBUTION (Fig. 21). Nicobar Islands.

MATERIAL EXAMINED

Paralectotypes. Nicobar Islands: 1 ♀, data as lectotype (genitalia slide no. 13168; BMNH); 1 ♂, Great Nicobars, 873 (genitalia slide no. 14682; BMNH).

Vitessa pyraliata Walker, 1864

(Figs 14, 21, 22, 30, 38, 41, 111–116, 164–166, 196, 197, 256–258, 302–304)

Vitessa pyraliata Walker, 1864 : 220.

♂, ♀. 46–58 mm. Frons: ♂ black lightly admixed with orange, ♀ orange, laterally black. Vertex: ♂ matt black lightly admixed with orange, ♀ orange lightly admixed with black. Eye, ocellus black. Chaetosema with pale yellow setae. Antenna black, base of scape in ♀ orange, dorsal scaling of apical third of shaft white, last several segments black. Labial palpus: ♂, first segment orange, second segment black or admixed with orange, third segment black; ♀, first segment dorsally black, ventrally orange, second segment black laterally streaked with orange to near tip, third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis glossy blue-black. Neck region orange. Thorax above: glossy blue-black, anteriorly bordered with variable amounts of orange, posteriorly tipped with white; patagium glossy blue-black, laterally and sometimes medially edged with variable amounts of orange; tegula glossy blue-black, laterally edged with variable amounts of orange. Abdomen above: black, posterior margins of segments with variable amounts of white, terminal segment posteriorly finely bordered with orange, anal tuft orange, medially brown. Body below: black; pectus orange; white abdominal lines broad, posterior margin of terminal segment and anal tuft orange. Legs black, white markings mostly on mid and hind legs; fore coxa black or black streaked with orange. Fore wing above: ground colour blue-black, fresh specimens with dark green hue; orange subbasal area variable, in ♂ restricted to small spot at base of cell, sometimes with orange scaling forming a weak subcostal streak, in ♀ sometimes large with broad subcostal streak continuing to base and joining white spot sometimes present at base of posterior margin, partially demarcating basal black spot; white antemedial fascia narrow, divided at cell into two spots, in ♂ anterior spot sometimes reduced to minute speck, posterior spot rectangular or triangular, not reaching posterior margin; white postmedial fascia oblique, divided at Cu_2 into two spots, large anterior spot circular, over discocellular vein, not reaching costa, posterior spot triangular in ♀, minute in ♂, sometimes with smaller spot anterior to it in ♀; terminal area with weak white vein-lines, sometimes absent in ♂; fringe basally dark grey, distally light grey. Hind wing above varying with subspecies; black terminal band broad, weakly

violaceous; infuscation from base sometimes extending across wing, almost obliterating white medial area, otherwise white medial area broadly reaching anal margin; fringe dark grey, distally white at apex and part of termen. Fore wing below: in ♂ dark brown with shaggy scaling, in ♀ blue-black, violaceous, partly with dark green hue, smoothly scaled, brownish fuscous in cubital region; in both sexes postmedial fascia as above, or with spots fused, white streak along anal fold; apical white vein-lines weakly developed in ♀, sometimes absent as in ♂; posterior margin white; retinaculum light grey. Hind wing below: ground colour as on fore wing, markings as above, apical vein-lines in ♀ weak or absent, in ♂ absent.

GENITALIA ♂ (Figs 30, 38, 41, 164–166, 196, 197). Generally as described for *V. nicobarica*. Uncus: marginal setae very long. Gnathos long, strongly curved, sickle-shaped. Transtilla V-shaped. Anterior sclerite of tegumen with long narrow medial emargination on anterior margin. Vinculum broad, anteriorly concave. Valve narrow, costa upturned to apex, apex narrowly rounded, termen broadly rounded, slightly oblique, ventral margin weakly excised below middle; clasper variable, a long diagonal ridge, basal part with cluster of short spines, remainder produced into three or four tooth-like, medially ridged processes of irregular size, those on ventral margin smallest and merging with mesal striations. Catena (Fig. 38) single, large, long, basally constricted, medially sulcate, tips diverging, varying in width posteriorly with multiple short spines, catena slightly separated from lateral ridged sclerites attached to dorsal processes of juxta (Figs 30, 196, 197). Aedeagus with strong sclerotization at junction with vesica, forming acute elbow-joint when vesica everted and reflexed (Fig. 41); vesica bearing three cornuti clusters, two large proximal dorsolateral clusters, one small distal ventrolateral cluster.

GENITALIA ♀ (Figs 256–258, 302–304). Generally as described for *V. nicobarica*. Posterior ostial sclerite (Figs 302–304) wide with short triangular lateral prolongations anteriorly directed, medial portion of anterior margin prolonged into a V-shaped flap with rounded upturned tip. Anterior sclerite with ventral margin short, recurved, slightly wrinkled and laterally denticulate; antrum posteriorly extending to anterior margin of posterior sclerite, medially narrowed and joined to base of upturned flap; anteriorly extending into large cup-shaped chamber. Ductus seminalis arising from base of antrum; ductus bursae slightly widened posteriorly, remainder of ductus narrow, anteriorly spinose; corpus bursae oval bearing minute denticulate areas, these sometimes absent.

REMARKS. This species is related to *V. nicobarica*, but is distinguished by possessing typical black and white hind wing markings in both sexes. It is variable over its range but the two subspecies *V. pyraliata latialbata* and *V. pyraliata pyraliata* are distinguished in the genus by a predominantly black and white appearance due to great reduction in all pale markings, especially on the fore wing and the undersides of both wings; the nominate subspecies from Sulawesi is best distinguished from *V. kolakalis*, from the same island, by the reduced orange subbasal area, by the rough underside scaling of the ♂ and by the genital characters of both sexes. The subspecies *V. pyraliata triangulifera* can easily be confused externally with *V. philippina* of the *stettina*-group, but is distinct on genital characters (see Diagnoses of the species-group, pp. 286, 303). Other species in the *pyraliata*-group are distinguished by their more extensive pale fore wing markings and by genital characters. We recognize three subspecies, from the following geographical areas: (1) Burma, Malaya, Sumatra, Java, Natuna Island, Borneo and western central Sulawesi; (2) Philippines; (3) south and south-western Sulawesi and Flores.

BIOLOGY. Early stages and host-plant unknown. Moths collected in all months of the year.

DISTRIBUTION (Figs 14, 21, 22). Burma; Malaya; Sumatra; Java; Natuna Island; Borneo; Philippines; Sulawesi; Flores.

***Vitessa pyraliata latialbata* subsp. n.**

(Figs 21, 30, 38, 111, 112, 164, 196, 256, 302)

♂, ♀. 46–58 mm. Generally as described for species. Labial palpus: in ♂ second segment laterally admixed with orange; in ♀ mostly orange. Patagium: in ♂ mostly blue-black, laterally and medially edged with orange; in ♀ orange with posteromedial blue-black spot; tegula: in ♂ blue-black with inner and outer edges finely orange; in ♀ more distinctly orange with anterolateral and posterior blue-black spot. Legs in ♂ black with mid and hind tibiae bearing small dorsal white spot and distally tipped with white; in ♀ most of fore coxa orange, ventral margins of mid and hind femora white, mid and hind tibiae medially banded with white, tibiae and tibial spurs distally tipped with white. Fore wing above with variable orange subbasal area, in ♂ restricted between posterior margin of cell and A_1 , with faint orange scaling or

defined subcostal streak continuing to base; in ♀ orange area larger, subcostal streak stronger. White antemedial fascia with fairly well-defined anterior spot and large rectangular posterior spot. White post-medial fascia sometimes with faint white scales behind posterior spot in ♀. Hind wing above with broad, well demarcated, blue-black terminal band, acutely angled and narrowing at Cu_2 ; infuscation from base weak, medial white area broadly extended to anal margin. Fore wing below with postmedial fascia diffusely fused into large oval in ♂, spots separate with slight diffusion in ♀.

GENITALIA ♂ (Figs 30, 38, 164, 196). Generally as described for species. Clasper with three or four tooth-like processes, largest being second from base.

GENITALIA ♀ (Figs 256, 302). As described for species.

REMARKS. This is distinguished from other subspecies by the very large white area of the hind wing, and the correspondingly minute amount of infuscation from base and costa. It is easily distinguished from *V. teleroma* of the *suradeva*-group, also from Malaysia, by the larger pectinations of the ♂ antenna; the smaller orange subbasal area and white antemedial fascia on the fore wing; the broader black terminal band on the hind wing; the rough scaling on the underside of the wings in the ♂; and by genital characters (see species-group diagnoses, pp. 303, 317). The subspecies is slightly variable over its considerable range. The arrangement of spines and processes on the clasper of the ♂ genitalia is somewhat variable. The data labels of Ceylon [Sri Lanka] and Australia on two specimens are dubious.

BIOLOGY. Early stages and host-plant unknown. Moths collected from January to July, September, November and December.

DISTRIBUTION (Fig. 21). Burma; Malaya; Sumatra; Java; Natuna Island; Borneo; western central Sulawesi.

MATERIAL EXAMINED

Holotype ♂, **Malaya**: Maxwell Hill [4°52' N, 100°48' E], 13.ix.1929 (*Corbet*) (BMNH).

Paratypes. **Malaya**: 1 ♂, Penang, 1896 (*Curtis*) (genitalia slide no. 15832; BMNH); 1 ♂, Pulo Penang ('Penang Island'), ex Boisdual coll. (BMNH); 1 ♂, Pulo Penang (*Teylingen*) (UZM, Copenhagen); 1 ♂, Pulo Penang (*Lövendal*) (UZM, Copenhagen); 1 ♂, 2 ♀, Taiping, 1972, iii, viii.1973 (HI, Iruma City); 1 ♂, Pahang, Fraser's Hill, i.1955 (*Tayleur*) (BMNH); 1 ♀, Pahang, Fraser's Hill, 27.iv.1958 (*Tayleur*) (BMNH); 1 ♂, 3 ♀, Pahang, Genting Tea Estate, 600 m ('2000 ft'), 1.iv, 22.vi, 16.x.1976 (*Barlow*) (BMNH); 7 ♂, Perak, 550–1200 m ('1800–4000 ft'), xii.1896–vi.1897 (*Curtis*) (BMNH); 1 ♀, Selangore, R[B]ukit Putus, 900 m ('3000 ft'), v.1896 (*Curtis*) (BMNH); 3 ♀, Selangor, 100 m ('300 ft'), x.1954 (*Banks*) (BMNH); 1 ♂, Perak (*Banks*) (BMNH); 2 ♂, 12 ♀, Bukit Kutu [3 32' N, 101 44' E], 1000 m ('3300 ft'), ix.1927–vii.1928, and no date (*Sanderson*) (genitalia slide no.'s 14651, 15833; BMNH); 18 ♂, 15 ♀ (including allotype), Maxwell Hill, 9–21.ix.1929 (*Corbet*) (genitalia slide no. 8261; BMNH); 1 ♂, Perak, Maxwell Hill, 1350 m ('4500 ft'), i.1955 (*Morrell*) (BMNH); 2 ♀, Perak, Maxwell Hill, 1350 m, iii.1958 (*Maa*) (BPBM, Honolulu); 6 ♂, 2 ♀, [Mt] Gunong Ijan (BMNH).

Material excluded from paratype series. **Burma**: 1 ♂, Tenasserim Valley, ii–iii.1889 (*Doherty*) (BMNH). **Sumatra**: 1 ♀, south-western Sumatra [?], W. slopes Barisan Range, 750 m, ix–xii.1921 (*Pratt*) (TM, Pretoria); 4 ♂, 2 ♀, south-western Sumatra, North Korintji Valley, 1500 m, ix–x.1921 (*C. F. & J. Pratt*) (BMNH; TM, Pretoria); 1 ♀, Lebong Tandai, Mt Lalangir, 1050 m, vii.1923 (*Brooks*); 1 ♂, 1 ♀, Fort de Kock, 900 m, iv.1921, 1924 (*Jacobson*) (RNH, Leiden); 1 ♀, east coast, Darat Bangkat, 1909 (*De Bussy*) (BMNH). **Java**: 3 ♂, Res. [Dutch health resort] Soekaboemi [Sukabumi, 6 58' S, 106 47' E], 1895 (*Ledru*) (BMNH); 1 ♂, Malang (*Walsh*) (RNH, Leiden); 1 ♀, no data (BMNH). **Natuna Island**: 2 ♂, Bunguran, vii–x.1894 (*Hose*) (BMNH). **Borneo**: 6 ♂, 8 ♀, Kalimantan, Dent Province, Mt Marapok (BMNH); 1 ♂, 4 ♀, K., Samarinda, viii–x.1938 (*Walsh*) (BMNH); 1 ♂, no data (BMNH); 5 ♂, Sarawak, Kuching (BMNH; UM, Oxford); 4 ♂, S., Kuching (*Hewitt*) (RSM, Edinburgh); 1 ♀, S., Matang, 1100 m, vi.1898 (BMNH); 1 ♀, S., Gunong Matang, 100 m, ix.1958 (*Gressitt & Maa*) (BPBM, Honolulu); 1 ♀, S., Bidi, 1907–1908 (*Brooks*) (BMNH); 1 ♀, S., Bau District, Bidi, 90–250 m, ix.1958 (*Maa*) (BPBM, Honolulu); 2 ♂, S., Gunong Mulu Nat. Park, Mulu, 1790 m, lower montane (moss) forest, MV – canopy, i.1978 (*Holloway et al.*) (BMNH); 1 ♀, S., Gunong Mulu Nat. Park, Mulu, 1780 m, lower montane forest, MV – canopy/understorey, i.1978 (*Holloway et al.*) (BMNH); 3 ♀, S., Gunong Mulu Nat. Park, Mulu, 150 m, mixed dipt. for. MV – mainly canopy, ii.1978 (*Holloway et al.*) (BMNH); 2 ♂, 1 ♀, S., Gunong Mulu Nat. Park, Mulu, 1000 m, lower montane for., MV – canopy/understorey, ii.1978 (*Holloway et al.*) (BMNH); 1 ♀, S., Gunong Mulu Nat. Park, Long Pala (Base), 70 m, Alluv./second. for., MV – on batu-canopy, iii.1978 (*Holloway et al.*) (BMNH); 1 ♀, S., Gunong Mulu Nat. Park, W. Melinau Gorge, 130 m,

alluvial/Kerangas bank, Acl.-u' storey, iii.1978 (*Holloway et al.*) (BMNH); 1 ♂, Gunong Mulu Nat. Park, G. Api, 900 m, lower montane forest, MV and Act., iv.1978 (*Holloway et al.*) (BMNH). **Sulawesi:** 1 ♀, Koelawi Paloe, 950 m, iii.1937 (*Kalis*) (BMNH). No data: 2 ♀, Dutch East Indies, no exact data (BMNH); 1 ♀, 999 (TM, Pretoria).

The following data are dubious: **Sri Lanka:** 1 ♂, no exact data (BMNH). **Australia:** 1 ♂, 'Australie', ex Guenée coll. (BMNH).

Vitessa pyraliata triangulifera subsp. n.

(Figs 14, 113, 114, 165, 257, 303)

♂, ♀. 50–58 mm. Generally as described for species. Labial palpus in ♂ black; in ♀ first segment dorsally black, ventrally orange, second segment black, with strong lateral orange streak, third segment black. Patagium and tegula glossy blue-black, latter with anteromedial orange spot. Legs mostly black in ♂, in ♀ hind femur ventrally white, mid tibia bearing small dorsal white spot, mid and hind tibiae tipped with white. Fore wing above: orange subbasal area restricted from below costa to A_1 , smaller in ♂. White antemedial fascia with anterior spot minute, mostly anterior to cell, posterior spot large, triangular, from behind cell to just past A_1 . White postmedial fascia sometimes with faint white scales anterior and posterior to posterior spot in ♀. Hind wing above with broad, well demarcated, blue-black terminal band, acutely angled and narrowing at Cu_2 ; infuscation from base fairly heavy, restricting white medial area to about half of anal margin. Fore wing below: postmedial fascia, spots separate with slight diffusion.

GENITALIA ♂ (Fig. 165). Generally as described for species. Clasper with two tooth-like processes, the more basal one the larger.

GENITALIA ♀ (Figs 257, 303). As described for species.

REMARKS. The external characters are much as in *V. pyraliata latialbata*, but the posterior white spot of the antemedial fascia on the upperside of the fore wing is smaller and triangular, not rectangular; the orange subbasal area is small in both sexes and lacks the subcostal streak to the base. In the hind wing this subspecies is distinct from *V. pyraliata latialbata* in having the white area more constricted by infuscation from base, especially in the ♂, but not so constricted as in the nominate subspecies. The ♀ is hardly distinguishable in external appearance from *V. philippina* of the *stettina*-group, which occurs sympatrically (the ♂ of *V. philippina* is unknown); *V. philippina* is smaller, with orange patagium and larger orange subbasal area, nearly reaching costa; its genitalia differ by the species-group characters (see Diagnosis, p. 286).

BIOLOGY. Early stages and host-plant unknown. Moths collected in February, May and August to November.

DISTRIBUTION (Fig. 14). Philippines.

MATERIAL EXAMINED

Holotype ♂, **Philippines:** Luzon, Benguet, Baguio (*Baker*) (NMNH, Washington).

Paratypes. **Philippines:** 1 ♀ (allotype), data as holotype (NMNH, Washington); 1 ♀, Luzon, Tabato, ii.1916 (NMNH, Washington); 14 ♀, Luzon, Mt Makiling (*Baker*) (genitalia slide no. 342 DK) (NMNH, Washington; CNC, Ottawa); 1 ♂, Luzon [with conflicting labels], Mt Makiling, 350 m ('1070 ft'), 12.ix.1936 (*Salmon*) [and] Los Banos, 22.viii.1921 (*Pearson*) (NMNH, Washington); 7 ♀, Luzon, Manila, 19.viii–16.x.1912 (*Wileman*) (genitalia slide no.'s 14704, 14705, 15144, 15145, 15835; BMNH); 1 ♀, Luzon prov. Rizal, Manila, plains, v.1912 (*Wileman*) (genitalia slide no. 15834; BMNH); 4 ♀, Mindanao, Surigao, xi. (NMNH, Washington; CNC, Ottawa); 1 ♀, Mindanao, 15 km south-west of Davao, Mt Apo School, 500 m, x.1955 (*Davis*) (NMNH, Washington); 1 ♀, Mindanao, Lanao, Butig Mts, 24 km NE. of Butig, 1080 m, in rain forest, 21.vi.1958 (*Milliron*) (BPBM, Honolulu); 1 ♂, no data (Type no. 2636; genitalia slide no. Oxford 723–1977, Shaffer; UM, Oxford).

Vitessa pyraliata pyraliata Walker, 1864

(Figs 22, 41, 115, 116, 166, 197, 258, 304)

Vitessa pyraliata Walker, 1864, *List Specimens lepid. Insects Colln Br. Mus.* 31 Supplement: 220.

LECTOTYPE ♀ [not ♂ as stated by Walker], SULAWESI ('Celebes') [(*Wallace*)] (genitalia slide no. 15828; BMNH), here designated [examined].

Vitessa pyraliata Walker; Ragonot, 1891 : 110.

Vitessa pyraliata Walker; Hampson, 1896b : 503.

Vitessa pyraliata Walker; Swinhoe, 1900 : 429.

♂, ♀. 46–58 mm. Generally as described for species. Labial palpus in ♂: second segment lightly admixed with orange; in ♀ second segment laterally orange to near tip. Patagium in ♂ glossy blue-black; in ♀ glossy blue-black, finely edged medially and laterally with orange. Tegula glossy blue-black with orange anteromedial spot. Legs in ♂: mid tibia with medial dorsal white spot; mid and hind tibiae tipped with white; in ♀, ventral surfaces of mid and hind femora white; medial white band and white tips on mid and hind tibiae. Fore wing above: orange subbasal area variable in size, from behind costa to *CuP*, smaller in ♂. White antemedial fascia with anterior spot minute, anterior to cell; posterior spot large, roughly triangular, from cell to just past *A*₁. White postmedial fascia with very large round spot over end of cell and discocellular vein, posterior spot on *CuP* minute. Hind wing above with broad, well-demarcated, blue-black terminal band in both sexes, with heavy infuscation from base; white medial area narrow in ♀, very narrow in ♂, almost to obliteration. Fore wing below: postmedial fascia forming large oval in ♂, two spots in ♀. Hind wing below: similar to upperside of ♀, sometimes restricted white area to centre of wing cut off from anal margin by infuscation.

GENITALIA ♂ (Figs 41, 166, 197). Generally as described for species. Clasper with two or three tooth-like processes, largest being second from base.

GENITALIA ♀ (Figs 258, 304). As described for species.

REMARKS. This subspecies is similar in size and external appearance to *V. pyraliata latialbata*, but is distinguished by the much-restricted white area of the hind wing in both sexes; it is distinguished from *V. pyraliata triangulifera* by the much-reduced posterior white spot of the postmedial fascia. It strongly resembles *V. kolakalis*, with which it flies over part of its range, but is distinguished by the smaller orange subbasal area and by the genitalia of both sexes, with clasper of valve in ♂ and without sclerotized depressed signa on corpus bursae in ♀. We have not traced the paralectotype from Seram collected by Wallace, mentioned by Walker in his description of *pyraliata*. It is probably not conspecific with the lectotype. All available Wallace specimens from the BMNH and UM, Oxford, collections have been examined. Swinhoe (1900 : 429) recorded two specimens from Makian, an island in the Moluccas south of Ternate, but these have not been traced.

BIOLOGY. Early stages and host-plant unknown. Moths collected in February, March, May, June and October.

DISTRIBUTION (Fig. 22). South-west and south-east Sulawesi; Flores.

MATERIAL EXAMINED

Sulawesi: 1 ♀, Makasar (Wallace) (UM, Oxford); 2 ♂, South Celebes (Everett) (BMNH); 1 ♂, 1 ♀, Bonthain, Indrulaman, 700 m, x.1895 (Everett) (BMNH); 4 ♀, near Maros, Tjamba, 450 m, ii.1938 (Kalis) (BMNH); 3 ♀, near Maros, Pangean, 600 m, iii.1938 (Kalis) (BMNH); 6 ♀, Goa, Malino, 1100 m, vi.1938 (Kalis) (BMNH); 1 ♀, Tombugu [Boengkoe 2°32' S, 121°58' E] (MNH, Paris); 1 ♀, Ulu Kolaka, 500 m, v–vi.1939 (Kalis) (BMNH). **Flores:** 1 ♂, no exact data (Everett) (BMNH); 1 ♀, no exact data (Wallace) (UM, Oxford).

Vitessa kolakalis sp. n.

(Figs 22, 117, 118, 167, 198, 259, 305)

♂, ♀. 46–50 mm. Generally as described for *V. pyraliata*. Frons and vertex orange. Antenna black, in ♂ white on terminal region more extensive. Labial palpus: first two segments orange, third segment black, buff-tipped. Patagium orange with medial blue-black spot in ♂, anteromedial in ♀. Tegula blue-black, anteromedially orange at extreme base, inconspicuous in ♂, more obvious in ♀. Abdomen above: black, a few light scales on posterior margins of some segments; anal tuft orange. Abdomen below: black, segments with broad white posterior bands, narrowed or interrupted medially. Legs black, coxae with scattered white spots; hind femur ventrally white; mid tibia with dorsal white spot; tips of mid and hind tibiae and of spurs white. Fore wing above: orange subbasal area broad, narrowly short of costa, extending to *A*₁; white streak at base of posterior margin; white antemedial fascia broadly divided at cell, anterior spot short of costa, posterior spot larger, triangular, short of posterior margin; white postmedial fascia divided at *Cu*₂, large anterior spot round, posterior spot more distal, triangular, medially directed; apical white vein-lines weak in ♂, strong in ♀, short of termen and postmedial fascia; fringe dark grey. Hind wing above: medial white area narrowly restricted; broad blue-black terminal band, medial edge angled at base of cell;

infuscation from base stronger in ♂; fringe dark grey, distally white at apex. Fore wing below: postmedial fascia narrowly divided into two spots; apical vein-lines weak in ♀, absent in ♂; pale antemedial streak on anal fold; without shaggy scaling in ♂. Hind wing below as above.

GENITALIA ♂ (Figs 167, 198). Generally as described for *V. pyraliata*. Uncus slender, evenly tapering, basal portion wider, basally waisted, foramen wide, posteriorly rounded; lateral setae of moderate length. Gnathos with medial process wide, short, strongly angled, hook-shaped. Transtilla arcuate. Valve narrow, costa very broadly inflated, apex and termen broadly angled, posterior margin strongly excised ante- and postmedially; strong subcostal ridge to apex; mesal surface with fine oblique striations, more lateral near clasper; clasper a long diagonal ridge, continuous with straight carina, free edge rising gradually to near posterior margin, rising abruptly, forming single, slightly recurved, acuminate process, the falling distal edge joining posterior margin of valve at upper end of postmedial excision. Sclerotized dorsal surface of sclerite on anellus reticulated (Fig. 198); broadly rounded emargination at base of sclerotized manica, filled with very wide dorsal catena; catena slightly narrowing basally and longitudinally ridged, distally spined.

GENITALIA ♀ (Figs 259, 305). Generally as described for *V. pyraliata*. Posterior ostial sclerite (Fig. 305) with V-shaped medial flap on anterior margin, recurved, extending above posterior margin. Antrum very wide posteriorly, slightly asymmetrical, box-shaped. Corpus bursae globular, with single round, depressed, denticulate signum and single sclerotized, diffuse, denticulate patch.

REMARKS. In Sulawesi this species is easily confused with *V. pyraliata pyraliata*, but is distinguished by the largely orange patagium, the wider white area on the hind wing of the ♂; on the fore wing by the more distinct spots of both fasciae in the ♂ and the larger orange subbasal area in both sexes; in the ♂ by the absence of shaggy scaling on the undersides of the wings; the genitalia have larger spines on the cornuti clusters in the ♂ and different ostial sclerotization in the ♀. *V. kolakalis* is distinguished from *V. hollandi wallacealis* of the *stettina*-group, which occurs in Sulawesi, by the smaller white markings on the fore and hind wings; similarly it differs from all other members of the *pyraliata*-group by the reduced markings. The ♂ genitalia differ from those of other members of the *pyraliata*-group (so far as known) by the shape of the valve and clasper and the size of the dorsal catena; the ♀ genitalia differ in the asymmetrical development of the signa. The species is most closely related to *V. pyraliata* and *V. sulaensis*.

BIOLOGY. Early stages and host-plant unknown. Moths collected from May to June.

DISTRIBUTION (Fig. 22). South-eastern Sulawesi.

MATERIAL EXAMINED

Holotype ♂, Sulawesi: Ulu Kolaka, 500 m, v-vi.1939 (*Kalis*) (genitalia slide no. 8265; BMNH).

Paratypes. 10 ♂, 6 ♀ (including allotype), data as holotype (genitalia slide no.'s 14699, 14700, 15836, 15837, 15838, 15839; BMNH).

Vitessa sulaensis sp. n.

(Figs 22, 119, 260, 306)

♂. Unknown.

♀. 46 mm. Generally as described for *V. pyraliata* and *V. kolakalis*. Frons and vertex orange. Antenna black, base of scape orange, terminal third of dorsal scaling of shaft white, last few segments fuscous. Labial palpus: first two segments orange, third segment fuscous. Patagium orange with anteromedial blue-black spot. Tegula blue-black, anteromedially orange at extreme base. Abdomen above: black, posterior margins of segments narrowly white, anal tuft orange. Abdomen below: like upperside, wider segmental white margins. Legs black, hind femur ventrally white; mid tibia with dorsal white spot; tips of mid and hind tibiae white. Fore wing rather wide; above: ground-colour blue-black with dark-green hue; orange subbasal area almost circular, narrowly short of costa, extending to A_1 ; white scales at base of posterior margin; white antemedial fascia divided at cell into two spots, anterior spot small, short of costa, posterior spot larger, broad, triangular, short of posterior margin; postmedial fascia divided at Cu_2 into two spots, anterior spot round, very large, posterior spot more distal, triangular, medially directed, with minute spot anterior to distal end; five short but wide vein-lines in apical area, widely short of termen and postmedial fascia; fringe dark grey. Hind wing above: base and costa narrowly infuscated; terminal band blue-black, violaceous, broad, tapering to anal margin, inner border irregular; anal margin edged with black; white medial area broadly extended to anal margin; fringe [worn] dark grey. Fore wing

below: postmedial fascia as above, more diffuse, posterior spot less distal; isolated white scales at apex; retinaculum light grey. Hind wing below as above.

GENITALIA ♀ (Figs 260, 306). Generally as described for *V. pyraliata*. Posterior ostial sclerite (Fig. 306) with low, broad, quadrangular-based, V-shaped medial flap on anterior margin, narrowly recurved. Dorsal wall of antrum broadly extended posteriorly, distinctly trapezoidal and broadly connected to V-shaped flap on posterior sclerite; sclerotization narrowly extended anteriorly, with concave end formed within funnel-shaped expansion of ductus bursae. Corpus bursae globular, with an unequal pair of elongate, depressed denticulate signa.

REMARKS. This species is close to *V. pyraliata*, but differs externally in the more distal posterior white spot of the postmedial fascia of the fore wing; it differs from *V. kolakalis* by the more extensive white wing markings, and from remaining species in the group by the broader black terminal band of the hind wing. It is distinct from all other species of the group in genital characters.

BIOLOGY. Early stages and host-plant unknown. Holotype collected in October.

DISTRIBUTION (Fig. 22). Moluccas: Sanana ('Sula Besi').

MATERIAL EXAMINED

Holotype ♀, **Moluccas:** Sula Besi, x.1897 (*Doherty*) (genitalia slide no. 14628; BMNH).

Vitessa muluana sp. n.

(Figs 22, 120, 261, 307, 318)

♂. Unknown.

♀. 52 mm. Frons, vertex orange. Eye, ocellus black. Chaetosema with pale yellowish setae. Antenna black, ventral and inner surfaces of scape orange; dorsal scaling of apical third of shaft white. Labial palpus, first two segments orange, dorsal surfaces admixed with black, third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis basally black. Neck region orange. Thorax above: orange with medial 8-shaped blue-black spot; patagium orange with small anteromedial blue-black spot; tegula orange, anterolaterally and distally blue-black. Abdomen dark brown, anteriorly matt, posteriorly glossy. Body below: pectus orange; thorax black, flecked with orange; legs blue-black, fore and hind coxae mostly orange, mid and hind femora ventrally creamy white, mid and hind tibiae with medial and distal creamy white spots. Fore wing broad; ground-colour blue-black, violaceous; orange subbasal area large, narrowly short of costa, obliquely extended to near posterior margin, narrow subcostal streak extending to base, partially demarcating blue-black basal spot, medial margin jagged; yellowish white streak at base of posterior margin; creamy white antemedial fascia divided at cell, small triangular anterior spot subcostal, posterior spot broadly triangular, short of posterior margin, medially diffuse; creamy white postmedial fascia divided at Cu_2 , anterior spot large, round, over discocellular vein, posterior spot a broad dash, more distal and medially diffuse; smaller streaks anteriorly and posteriorly at distal end; an additional minute spot between M_3 and Cu_1 ; terminal area with subapical white vein-lines extending to Cu_1 ; fringe dark grey. Hind wing above: infuscation from base and costa very narrow; terminal band blue-black, violaceous, broad at apex, acutely angled to past Cu_3 , narrowing and finely terminating at anal margin; anal margin finely edged with black; white medial area very broad, extending over most of anal margin; fringe basally dark grey, distally light grey at apex, white to anal margin. Fore wing below: black, slightly violaceous; posterior margin basally white; white postmedial fascia with spots less clearly defined than above, finely separated at Cu_2 , basally diffuse; retinaculum light grey. Hind wing below: as above with weak white vein-lines to Cu_2 .

GENITALIA ♀ (Figs 261, 307, 318). High, wide, posteriorly prolonged ovipositor lobes, dorsally fused, surface densely setose, longer setae on margin, spiny setae conspicuous at $\times 25$ magnification (Fig. 318). Apophyses fairly short, slightly curved, tips truncated, anterior pair thicker. Posterior ostial sclerite (Fig. 307) wide, posterior margin with medial sclerotization weak and partially emarginated; sclerite anteriorly tripartite, short lateral prolongations ending anteriorly in tooth-like points; medial section also tripartite, with short triangular, anteriorly directed lateral prolongations, medial area concave; ventrally, a shallow, slightly oblique, lateral pouch extending from mid way along prolongation of medial area to lateral margin of sclerite, free edge finely denticulate. Anterior sclerite with ventral margin very short, sclerotization strongest laterally, broadly wrinkled, inner surface finely denticulate, medially membranous; antrum mostly anterior to ventral margin, asymmetrical, very narrow, about half width of

posterior sclerite; posteriorly pyramidal, but last third quadrangular and fused to concave medial area of posterior sclerite; anteriorly with a weak transverse fracture-line in sclerotization, separating pyramidal area from asymmetrical, funnel-shaped and collar-like area, ventral surface of latter present on one side only, triangular. Ductus bursae narrowly expanded posteriorly, twisted to one side at junction with antrum, short duct anteriorly spinose; corpus bursae large and bearing a pair of sclerotized, depressed, irregularly shaped, denticulate signa.

REMARKS. We do not know the ♂ of this striking and distinctive species and its systematic position is as yet not fully ascertained; it may well need its own species-group. The white markings of the fore wing suggest relationship with the *pyraliata*-group, particularly with *V. nicobarica*, though they are closest in appearance to those of *V. teleroma* of the *V. suradeva*-group. The narrowness of the terminal band of the hind wing closely resembles those of the *V. plumosa*-group and *V. teleroma*. In the genitalia the antrum bears some resemblance to that of *V. gemina*, of the present group; the signa show affinity to this group as well; the spiny setae, which tend to be well developed in the *pyraliata*-group, are more conspicuous than in any other species of the genus.

BIOLOGY. Early stages and host-plant unknown. Moths collected in March and August to December.

DISTRIBUTION (Fig. 22). Borneo: Sarawak; Sabah.

MATERIAL EXAMINED

Holotype ♀, **Borneo**: Sarawak, Mt Mulu, 300–1200 m ('1000–4000 ft'), viii–xii.1894 (*Hose*) (genitalia slide no. 15846; BMNH).

Paratypes. **Borneo**: 1 ♀, Sabah, Park HQ, Mt Kinabalu State Park, 1550 m, 20.iii.1975, m/v light (*Munroe*) (genitalia slide no. 5196 DK; CNC, Ottawa).

Vitessa gemina sp. n.

(Figs 3, 121, 122, 262, 308)

♂. Unknown.

♀. 42–48 mm. Frons, vertex orange, latter admixed with black. Eye, ocellus brown. Chaetosema with pale yellowish setae. Antenna black, ventral and inner surfaces of scape orange, dorsal scaling of apical third of shaft heavily admixed with white. Labial palpus: first two segments orange, third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis black, heavily admixed with orange. Neck region orange. Thorax above: blue-black, anteriorly and posteriorly orange; patagium orange, with large, posteromedial, glossy blue-black spot; tegula orange, with very large anterolateral and terminal glossy blue-black spots. Abdomen above: blackish fuscous, anal tuft orange. Body below: pectus orange; thorax blue-black, large yellow spot below tegula; abdomen with posterior margins of segments narrowly creamy white, anal tuft orange. Legs black, partly with dark green hue; fore coxa dorsally flecked with orange, ventrally white; mid and hind coxae with whitish grey bands; mid and hind femora ventrally white; mid tibia with dorsal medial white spot; mid and hind tibiae tipped with white. Fore wing of moderate width; above: ground colour glossy blue-black; orange subbasal area large, narrowly short of costa, obliquely extended to near posterior margin, narrow subcostal streak, sometimes incomplete, extending to base, partially demarcating large blue-black basal spot, medial margin broadly indented at cell and A_1 ; white antemedial fascia divided at cell, small anterior triangular subcostal spot, large posterior triangular spot short of posterior margin, both medially directed; white postmedial fascia divided at Cu_2 , anterior, large, round spot over discocellular vein, posterior, small, diffusely triangular, more distal spot; terminal area with white vein-lines on most veins, indistinct after Cu_1 , reaching termen, but narrowly short of postmedial fascia; fringe dark grey. Hind wing above, small amount of infuscation from base and narrowly from costa, terminal band blue-black, violaceous, broad at apex, acutely angled to past Cu_2 , very narrow at termen, abruptly terminating at anal margin; anal margin finely edged with black; white medial area wide, broadly extended to anal margin; fringe basally dark grey, distally light grey. Fore wing below: black, slightly violaceous; posterior margin basally white; white postmedial fascia with spots less clearly defined than above, finely separated at Cu_2 , basally diffuse; weak white apical vein-lines to M_3 ; retinaculum dark grey. Hind wing below as above, weak vein-lines to Cu_1 .

GENITALIA ♀ (Figs 262, 308). High, broad, posteriorly prolonged ovipositor lobes, dorsally fused, surface densely setose, longer on margin; spiny setae fairly conspicuous at $\times 25$ magnification. Posterior apophysis short, slender, slightly curved, tip spatulate. Anterior apophysis long, thick, curved, tip spatulate. Posterior

ostial sclerite (Fig. 308) broad, long, with wide lateral prolongations, each with two broad transverse constrictions; posterior margin with shallow medial emargination; anterior margin with medial area sharply differentiated into a laterally constricted quadrangle, demarcated posteriorly by a convex fold. Anterior sclerite broad, with ventral margin recurved, heavily wrinkled; posterior dorsal wall of antrum medially prolonged, narrowly dome-shaped, connected to medial quadrangular area of posterior sclerite; dorsal and ventral wall of antrum narrowly extended anteriorly, slightly asymmetrical, broadly concave and funnel-shaped at junction with expanded end of ductus bursae; ductus bursae slightly convoluted posteriorly, spinose anteriorly; corpus bursae oval, bearing minute paired denticulate areas.

REMARKS. This species closely resembles *V. hollandi hollandi* of the *stettina*-group in external appearance, and can be distinguished reliably only by examination of the genitalia. The ♀ genitalia are distinct from those of the rest of the *pyraliata*-group.

BIOLOGY. Early stages and host-plant unknown. Moths collected between May and June and between August and September.

DISTRIBUTION (Fig. 3). New Guinea: Irian Jaya (Kepulauan Schouten).

MATERIAL EXAMINED

Holotype ♀, **New Guinea**: Irian Jaya (Kepulauan Schouten), Mefor ('Numfoor'), Suer, v-vi.1897 (*Doherty*) (genitalia slide no. 14638; BMNH).

Paratypes. **New Guinea**: 3 ♀, Irian Jaya (Kepulauan Schouten), data as holotype (genitalia slide no.'s 14684, 15139, 15840; BMNH); 1 ♀, I. J., Mefor Island, Geelvink Bay, 15.viii-10.ix.1920 (*C., F., & J Pratt*) (TM, Pretoria); 3 ♀, I. J., Biak, 1896 (*Doherty*) (genitalia slide no. 14683; BMNH).

Vitessa splendida Schultze, 1908

(Figs 14, 123, 263, 309)

Vitessa splendida Schultze, 1908, *Philipp. J. Sci.* 3 (1) A : 35, pl. 1, fig. 11. Holotype ♀, **PHILIPPINES**: Negros Occidental, Maa, xi.1902 (*Banks*) (originally in Entomological Collection, Bureau of Science, Manila; now destroyed).

♂. Unknown.

♀. 44-46 mm. Frons, vertex orange. Eye, ocellus black. Chaetosema with pale yellowish setae. Antenna black, ventral surface of scape orange, dorsal scaling of apical third of shaft [presumably] white [antennae damaged]. Labial palpus: first two segments orange, third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis blue-black. Neck region orange. Thorax above: orange, large blue-black medial spot, posteriorly tipped with yellowish white; patagium glossy blue-black, laterally tipped and medially edged with orange; tegula orange with longitudinal, broad, glossy blue-black stripe along entire length. Abdomen above, matt fuscous; posterior margins of segments narrowly white, anal tuft orange. Body below: pectus orange; thorax black, banded with white; abdomen with posterior margins white, broader than above, anal tuft orange. Legs blue-black, partly with dark green hue; fore coxa dorsally flecked with orange, ventrally white; mid and hind coxae spotted with white; mid and hind femora ventrally white; mid and hind tibiae with medial bands and tips white, outer surfaces of spurs white; hind tarsus with dorsal white spot at end of first segment. Fore wing of moderate width; above: ground-colour glossy, green-black; orange subbasal area large, narrowly short of costa, short of posterior margin but passing A_1 , medial margin sinuate, narrow streaks at subcostal and A_1 regions extended to base, the subcostal streak broader, the anal streak weak and sometimes parted at centre, the streaks demarcating a blue-black oval basal spot; creamy white antemedial fascia divided by a wedge at cell, anterior spot subcostal, narrowly triangular, medially directed, posterior spot larger, basal margin level with anterior spot, slightly short of posterior margin, broadly triangular, medially diffuse; creamy white postmedial fascia divided at Cu_2 , large round anterior spot over discocellular vein, posterior spot smaller, narrowly triangular, more distal, medially directed, minute white scaling anterior and posterior to terminal edge; terminal area with strong creamy white vein-lines, extending from termen but short of postmedial fascia; fringe dark grey. Hind wing above: slight basal and narrow costal infuscation; violaceous blue-black terminal band, broad at apex, evenly tapering to anal margin, white medial area large, broadly extended to white anal margin; fringe basally dark grey, distally white at apex. Fore wing below: black, slightly violaceous; weak subcostal white streak from base; posterior margin shiny yellowish fuscous, broadly white at base; well-developed white postmedial spots; weak white apical vein-lines; fringe dark grey; retinaculum light grey. Hind wing below as above, weak white apical vein-lines; fascia white, dark grey at base of termen.

GENITALIA ♂ (Figs 263, 309). High, wide, posteriorly prolonged ovipositor lobes, dorsally fused, surface densely setose, larger setae on margin, spiny setae visible but not conspicuous at $\times 25$ magnification. Apophyses short, slightly curved, tips bluntly spatulate, anterior pair thicker. Posterior ostial sclerite (Fig. 309) very broad, densely sclerotized, with long, wide, anteriorly directed, lateral prolongations; posterior margin heavily sclerotized, medially swollen and slightly recurved, curved transverse pleats converging on swollen margin; anterior margin medially with short lateral prolongations joining antrum. Anterior sclerite very broad, ventral margin long, recurved, medially wrinkled, laterally minutely spinose on membranous area; posterior dorsal wall of antrum with posterior edge recurved, converging broadly and joining medial margin of posterior sclerite; very long anterior extension of antrum symmetrical, heavily sclerotized, dorsal wall broadly bowl-shaped, ventral wall with deep triangular folds on either side of opening of ductus bursae; posterior end of ductus bursae slightly swollen and pleated, remainder minutely spinose, merging gradually with oval corpus bursae; the latter bearing a single denticulate area.

REMARKS. The wing markings resemble those of *V. plumosa* and *V. suradeva* but differ in having less extensive white fasciae, and in the fasciae not being joined by medial streaking; the white terminal vein-lines are close to, but do not join the postmedial fascia; the shorter orange subbasal area does not reach the posterior margin. Superficially the species resembles other Philippine species: *V. philippina* of the *stettina*-group and *V. pyraliata triangulifera* of the *pyraliata*-group, but it differs by the larger orange subbasal area and larger white medial area of the hind wing. This species is very distinct on genital characters. The holotype of *V. splendida* was destroyed during the Second World War, but it was well figured by Schultze and the NMNH specimens have at one time been compared with the holotype. As material from Negros Island is not available, we do not designate a neotype.

BIOLOGY. Early stages and host-plant unknown. Moths collected in May, August, September and November.

DISTRIBUTION (Fig. 14). Philippines: Manila to Mindanao and Palawan.

MATERIAL EXAMINED

Philippines: 1 ♂, Luzon, Manila, ix.1912 (*Wileman*) (BMNH); 3 ♀, Luzon, Mt Makiling (*Baker*) (NMNH, Washington; CNC, Ottawa); 1 ♂, Mindanao, Surigao, xi (BMNH); 1 ♀, Mindanao, Subprov. Lanao, Kolambugan, sea level, v.1914 (*Wileman*) (BMNH); 1 ♀, Palawan, Brookes Point, Uring Uring, viii.1961 (ZM, Copenhagen).

The *plumosa*-group

DIAGNOSIS. Wing markings basically as in the *stettina*- and *suradeva*-groups, but white antemedial fascia with two long acuminate streaks on *R* and *Cu*, bordering a V-shaped indentation, extending to postmedial fascia; white postmedial fascia divided into an oval anterior spot and two distinct, narrowly triangular, basal spots, anterior and posterior to A_{1+2} . ♂ genitalia with distal portion of uncus down-curved then up-turned, narrowed, with laterally directed setae, as in the *pyraliata*-group and several others; valve with slight distal expansion; clasper with prominent, bifid, anteromedially directed process, not paralleled in other groups; base of long oblique clasper showing affinities with the *hemiallactis*- and *pyraliata*-groups. Ostial chamber of ♀ genitalia with long ventral margin of anterior sclerite more strongly developed than in any other species-group.

Vitessa plumosa Hampson, 1896

(Figs 22, 31, 39, 124–127, 168, 169, 199, 200, 216, 264, 265, 310, 311)

Vitessa plumosa Hampson, 1896b : 503.

♂, ♀. 38–52 mm. Frons, vertex orange. Eye, ocellus brown. Chaetosema with pale yellowish setae. Antenna black, anterior surface of scape basally orange; dorsal scaling of apical third of shaft black, sometimes with isolated white scales, exceptionally with an extensive white zone; terminal segments fuscous. Labial palpus: first two segments orange, sometimes admixed with black, third segment black. Maxillary palpus basally black, distally orange. Basal scaling of proboscis blue-black. Neck region orange. Thorax above: orange, 8-shaped blue-black medial area, posteriorly tipped with pale yellow; patagium orange with variable-sized, posteromedial, glossy blue-black spot; tegula orange with variable-sized, longitudinal, glossy blue-black medial band. Abdomen above: black, posterior margins of segments broadly white,

posterior segment blue-black, laterally orange, anal tuft orange. Body below: black with greenish hue; pectus orange; white abdominal margins broader than above; posterior half of terminal segment and anal tuft orange. Legs black with greenish hue; fore coxa dorsally orange, ventrally white; mid and hind coxae banded with white; fore femur ventrally edged with orange; mid and hind femora ventrally white; mid and hind tibiae medially banded and tipped with white; tibial spurs white; hind tarsus with dorsal posterior tip bearing white dot. Fore wing rather narrow; above: ground-colour glossy blue-black with dark green hue; orange subbasal area large, narrowly short of costa and posterior margin, medial margin sinuate, sometimes with subcostal medial extension, subcostal streak extending to base, basal margin protruding at *CuP*, basal blue-black spot partly demarcated; white antemedial fascia with basal margin incurved, especially towards costa, narrow black medial wedge at cell sometimes dividing fascia, anterior spot a narrow triangular streak, medially directed and acuminate, sometimes touching postmedial fascia, posterior area with medially directed and acuminate triangular extension touching postmedial fascia, base narrowing to near posterior margin; white postmedial fascia distinctly divided into four markings, divisions at *Sc*, *Cu*₂ and *A*₁, a long thin subcostal line, a large oval discocellular spot with slight terminal indentation, posterior to this a narrowly triangular, medially directed spot, nearly touching antemedial fascia, shorter in ♂, the most posterior streak slightly thinner, short of posterior margin, terminal margin of fascia slightly oblique or at right angles to posterior margin; terminal area with thick white vein-lines extending from termen to postmedial fascia; fringe dark grey. Hind wing above: narrow infuscation from costa, violaceous blue-black terminal band, broad at apex, gradually tapering or strongly angled at *Cu*₂ and narrow to anal margin; large white medial area, broadly extending to white anal margin; fringe basally grey, distally white. Fore wing below: ground-colour blue-black, violaceous; orange-brown area around white retinaculum; posterior margin broadly white from base; short white subcostal streak from base, lightly admixed with yellow; white postmedial fascia with large discocellular spot indented terminally, a smaller, less distinct, more distal spot posterior to *Cu*₂; white vein-lines apically, minutely at termen to *Cu*₂; fringe grey. Hind wing below as above, white along costa apically, apical vein-lines continued minutely on termen to *Cu*₁; fringe white.

GENITALIA ♂ (Figs 31, 39, 168, 169, 199, 200, 216). Uncus long, slender, narrowly constricted at tegumen, with pronounced lateral flanges; base slightly constricted, gradually tapering, bearing long narrow foramen; distal portion rod-like with sparse, short lateral setae, de-curved then up-turned to acuminate tip. Gnathos with wide lateral arms, converging to a long, compressed, acuminate, scythe-shaped medial process, not as long as uncus. Transtilla arcuate, medially broadened, posterior margin sometimes medially excised, lateral flexure pronounced. Tegumen with posterior sclerite broad, rounded; anterior sclerite with very broad medial emargination. Vinculum broad, basally concave. Valve narrow, base narrowly inflated, costa sinuate, apex pronounced, narrowly rounded, termen broadly rounded, posterior margin sinuate towards base; mesal surface with finely converging oblique striations; clasper with oblique base separated from crease-like carina, base abruptly upturned, forming prominent, bifid, anteromedially directed process, distal side curving gradually, forming raised serrate ridge terminating close to posterior margin shortly before terminal angle. Juxta with large, narrow lateral sclerites (Fig. 31), very long, flat, narrow, upturned, ventral process; dorsal process broader, shorter, bearing setae, directly connected to ridged sclerite on anellus (Figs 199, 200); large narrow catena (Fig. 39) between sclerites, heavily sclerotized, constricted anteriorly, deeply ridged, tips laterally diverging, multiple spines posteriorly; manica supported by sclerotized bands. Aedeagus long, distally expanded, base narrowly rounded; ductus ejaculatorius subbasal; vesica with spines spreading ventrally to distal end of aedeagus, here membrane bulbous and transversely rugose; vesica sharply tapering distally; dorsally spinose, longitudinally rugose, lightly sclerotized; sclerotized junction with aedeagus forming a sharp elbow-joint when vesica everted and reflexed; three cornuti clusters (Fig. 216); two dorsolateral; the left with long, short-spined sclerotized bar, large spines posteriorly, the right lacking bar, smaller patch of spines posteriorly; one ventrolateral cluster with large spines.

GENITALIA ♀ (Figs 264, 265, 310, 311). High, wide, posteriorly prolonged ovipositor lobes, dorsally fused; surface densely setose, longer setae on margin, spiny setae visible but not conspicuous at $\times 25$ magnification. Apophyses slightly curved, tips truncate; anterior pair longer, thicker. Posterior ostial sclerite (Figs 310, 311) broad with long lateral prolongations; posterior margin medially emarginate, thickened, slightly recurved; sclerite with lateral transverse ridge and oblique, shallow, pouch-like invagination; lateral prolongation constricted, with ventromedial edge deeply recurved; anterior margin medially elongated, bearing small recurved flap. Anterior sclerite with very long ventral margin, half as wide as sclerite, recurved, wrinkled, minutely spinose laterally; antrum posteriorly broad and rounded, margin joined to recurved edge of lateral prolongation and medial flap of posterior sclerite; anterior development long, forming large funnel-shaped structure, ventral wall producing sclerotized base of ductus seminalis, dorsal

wall with deep V-shaped in-fold; antrum merging with swollen end of ductus bursae; ductus bursae long, slender, medially spinose; corpus bursae globular, bearing a pair of minute denticulate areas.

REMARKS. This species most closely resembles *V. suradeva*, but the long triangular medial streaks of the antemedial fascia on the fore wing are very distinctive. An unusual feature of *V. plumosa* is the frequent great restriction of white dorsal scaling on the antenna. Very few specimens examined had the normal antennal pattern. The genitalia are distinctive in both sexes. There is some variation in this species, at least partially geographically correlated. Specimens from Sumbawa and Lombok are larger than others and have the subbasal area of the fore wing relatively restricted; those from Bali in the west and from the eastern part of the Lesser Sunda chain are smaller and have the orange area larger. More material will be needed to determine whether these apparent geographical correlations are consistent. A long series from Salajar appears consistently different from specimens from the Lesser Sunda Islands. For the present we recognize two subspecies, from the following geographical areas: (1) Bali; Lombok; Sumbawa; Kalao; Timor and Damar; (2) Salajar.

BIOLOGY. Early stages and host-plants unknown. Moths collected in January, April and from September to December.

DISTRIBUTION (Fig. 22). Lesser Sunda Islands and Salajar.

Vitessa plumosa plumosa Hampson, 1896
(Figs 22, 31, 39, 124, 125, 168, 199, 216, 264, 310)

Vitessa plumosa Hampson, 1896b, *Trans. ent. Soc. Lond.* **1896** : 503. Holotype ♂, SUMBAWA: ix.1891 (Doherty) (genitalia slide no. 8256; BMNH) [examined].

Vitessa plumosa Hampson; Pagenstecher, 1898 : 200.

♂, ♀. 41–52 mm. Generally as described for species. Antenna completely black. Fore wing above: orange subbasal area variable in width; white antemedial fascia sometimes divided at cell. Hind wing above: black terminal band broad at apex, abruptly narrowing at Cu_2 , narrow to anal margin.

GENITALIA ♂ (Figs 31, 39, 168, 199, 216). As described for species.

GENITALIA ♀ (Figs 264, 310). As described for species.

REMARKS. Topotypical specimens from Sumbawa and specimens from Lombok are larger than the material from other islands, including the subspecies *salayerensis*, with proportionally larger genitalia and broader fore wings. Material from Bali and the islands east of Sumbawa do not conform exactly with the Lombok–Sumbawa series; these specimens have slightly wider orange subbasal areas, similar to those in the Salajar series, and the hind wing markings are somewhat intermediate between the two subspecies. However, the material grouped under the nominate subspecies differs consistently from the Salajar subspecies by the shape of the terminal band on the hind wing, the narrowness of which, after passing Cu_2 , is similar to that in *V. teleroma* of the *suradeva*-group. It is likely that more material will show that additional subspecies should be recognized in the lesser Sunda Islands.

BIOLOGY. Early stages and host-plant unknown. Moths collected in January, April, and from September to December.

DISTRIBUTION (Fig. 22). Lesser Sunda Islands from Bali to Damar.

MATERIAL EXAMINED

Bali: 1 ♂, West Bali, Mondoktoempang, 750 m, x.1934 (*Kalis*) (BMNH). **Lombok**: 4 ♂, 1 ♀, Sapit, 600 m, iv–vi.1896 (*Fruhstorfer*) (BMNH; RNH, Leiden). **Sumbawa**: 1 ♂, ix.1891 (*Doherty*) (BMNH). **Kalao**: 1 ♀ [paralectotype of *Vitessa teleroma* Swinhoe] (BMNH). **Timor**: 1 ♂, Oinainisa ('Oinanissa') [64.3 km from Kupang, 600 m], xi–xii.1891 (*Doherty*) (BMNH); 1 ♀, Suai, i.1918 (*Wahr*) (BMNH). **Damar**: 1 ♀, Dammer, xii.1898 (*Kühn*) (BMNH).

Vitessa plumosa salayerensis subsp. n.
(Figs 22, 126, 127, 169, 200, 265, 311)

♂, ♀. 38–44 mm. Generally as described for species. Antenna black, posterior surface of apical third of shaft either with isolated white scales or with extensive white scaling. Fore wing above: orange subbasal area slightly variable but moderately wide; white antemedial fascia with large medial indentation, but never divided completely. Hind wing above: black terminal band broad at apex, gradually tapering to anal margin.

GENITALIA ♂ (Figs 169, 200). As described for species.

GENITALIA ♀ (Figs 265, 311). As described for species.

REMARKS. Specimens of this subspecies are consistently smaller than topotypical specimens of the nominate subspecies, but about the same size as specimens from Bali, Kalao, Timor and Damar. The fore wing is narrower, the orange subbasal area is generally wider. The hind wing has the black terminal band more evenly curved, wider in the cubital area than in the nominate subspecies, and with the medial margin either fairly straight or evenly curved. In the ♂ genitalia the valve is slightly narrower, especially at the terminal margin.

BIOLOGY. Early stages and host-plant unknown. Moths collected in December.

DISTRIBUTION (Fig. 22). Salajar.

MATERIAL EXAMINED

Holotype ♂, **Salajar** ('Seleyer'): Somarisi, 500 m ('1660 ft'), xii.1938 (*Kalis*) (BMNH).

Paratypes. 54 ♂, 73 ♀ (including allotype), data as holotype (genitalia slide no.'s 14652, 14653, 15843, 15844; BMNH).

The *suradeva*-group

DIAGNOSIS. Wing pattern variable, but basically as in the *stettina*-group; antemedial fascia not with long, acuminate, distal streaks on *R* and *Cu* as in the *plumosa*-group. Hind wing with white basal and distal area and contrasting blackish fuscous terminal band. ♂ genitalia with basal portion of uncus very wide, distal portion rod-shaped, down-curved then up-turned, with long lateral setae; valve with distinctive subquadrate outline, costa strongly bent subbasally, valve consequently opening in dorsal-ventral preparation at right angles, not at an acute angle, to tegumen and uncus; termen of valve nearly truncate; clasper a low flange, with small angular, ventrally directed, scoop-like process. The ♀ genitalia with posterior sclerite of ostial chamber reduced and lightly sclerotized; anterior sclerite with antrum heavily sclerotized, very large and pouch- or sack-shaped, more extensive than in other species-groups.

Vitessa teleroma Swinhoe, 1906

(Figs 23, 128–130, 170, 201, 217, 266, 312)

Vitessa teleroma Swinhoe, 1906, *Ann. Mag. nat. Hist.* (7) **18** : 412. LECTOTYPE ♂, MALAYA: Perak, 1907–128 (genitalia slide no. 8255; BMNH), here designated [examined].

♂, ♀. 42–50 mm. Frons, vertex orange. Eye brown. Ocellus minute or absent. Chaetosema with pale yellowish setae. Antenna black, anterior surface of scape basally orange; dorsal scaling of apical third of shaft white, last several segments fuscous. Labial palpus: first two segments orange, third segment black, inner surface and tip with light admixture of orange in ♀. Maxillary palpus basally black, distally orange. Basal scaling of proboscis glossy blue-black. Neck region orange. Thorax above: orange, 8-shaped medial blue-black area, posterior margin white; patagium orange with posteromedial glossy blue-black spot; tegula with anterolateral glossy and terminal blue-black spot. Abdomen above: first segment white, remaining segments black, posterior margins white, progressively narrowing to anal end, terminal segment with posterior margin and anal tuft orange. Body below: black; pectus orange; abdomen as above from second segment on. Legs black; fore coxa dorsally black admixed with orange, ventrally edged with white; fore femur posteroventrally tipped with white; mid and hind femora ventrally white; mid and hind tibiae with broad medial white band; tibiae posteriorly tipped with white; tibial spurs white, admixed with black in ♀. Fore wing above: ground-colour blue-black with dark green hue. Orange area basal, subcostal, sometimes extending to posterior margin, base of posterior margin white; orange subcostal streak to base, narrower streak to base on *CuP*, sometimes broken, demarcating large round blue-black spot from *Sc* to *CuP*, narrower oblique blue-black spot in cubital area; fairly wide blue-black subcostal fascia; white

antemedial fascia just short of costa and posterior margin, divided at cell, small anterior spot narrow and triangular, posterior spot larger, rectangular; white postmedial fascia short of costa and posterior margin, divided at Cu_2 in ♂, anterior spot large, oval, over discocellular vein, traces of subcostal streak towards apex, posterior spot smaller, more distal, triangular, directed along CuP ; in ♀ subcostal streak stronger, smaller white streaks anterior and posterior to posterior spot; terminal area with all veins white, thicker in ♂, extending from termen, short of posterior spots of postmedial fascia; fringe dark grey. Hind wing above: narrow infuscation from costa, blue-black, violaceous terminal band, broad at apex, gradually tapering to anal margin in ♂, narrower in ♀ and abruptly angled at Cu_2 , finely tapering to anal margin; large white medial area broadly extending to and including most of anal margin. Fore wing below: black, violaceous; white subcostal streak at base; broad white streak at posterior margin; white postmedial fascia as above, weaker, more diffuse; short, weak, white apical vein-lines, more extensive in ♀; retinaculum white; fringe as above. Hind wing below: as above; costa edged with white; short, weak apical vein-lines, more extensive in ♀; fringe white.

GENITALIA ♂ (Figs 170, 201, 217). Uncus long, de-curved then up-turned; basal portion very wide, flattened, laterally constricted, with long narrow foramen; distal portion rod-like with short sparse lateral setae. Gnathos with wide lateral arms, converging to a long, compressed, acuminate, claw-shaped medial process, not as long as uncus. Transtilla V-shaped, medially broadened, high, pronounced lateral flexure. Tegumen: posterior sclerite broad with posterior margin straight; anterior sclerite with narrow medial emargination. Vinculum broad, basally concave. Valve long, costa basally strongly arched, then straight and parallel to posterior margin, narrowly inflated for most of length, up-turned to apex; apex sub-truncate; termen broadly rounded; posterior margin sinuate; mesal surface with fine longitudinal and oblique striations; clasper with small, oblique, raised basal ridge, separated from crease-like carina, not meeting free edge of distal part of clasper, a free edge rising abruptly, recurving to form round raised scoop-like process, becoming tubular and distally tapering, running parallel to posterior margin, terminating at two-thirds length. Juxta with large, narrow lateral sclerites; ventral process very long, flat, narrow, up-turned; dorsal process broader, shorter, up-turned near centre and bearing setae, directly connected to long curved sclerite on anellus, longitudinally ridged and bearing spines; between spiny sclerites a large, narrow, oval, sclerotized catena, longitudinally creased, medially and distally spined (Fig. 201); manica supported by sclerotized bands. Aedeagus long, distally expanded, base narrowly rounded; ductus ejaculatorius subbasal; vesica with spines spreading ventrally to distal end of aedeagus, here membrane bulbous and transversely rugose; vesica of even width, abruptly narrowing after cornuti clusters; vesica dorsally spinose and longitudinally rugose; junction with sclerotized aedeagus forming elbow-joint when vesica everted and reflexed; two ventrolateral cornuti clusters (Fig. 217), variable in length, each with long spines, left cluster two to four times as long as right, with about 40–80 spines, right cluster with about 20–30 spines.

GENITALIA ♀ (Figs 266, 312). High, narrow, posteriorly prolonged ovipositor lobes, dorsally fusing, surface densely setose, longer setae on margin, spiny setae visible but not conspicuous at $\times 25$ magnification. Eighth tergite with anteromedial margin long, broadly rounded. Posterior apophysis short, thin, nearly straight; anterior apophysis longer, broader, curved, tip spatulate. Posterior ostial sclerite (Fig. 312) weakly sclerotized, weakly constricted laterally and ventrally; posterior margin shallowly V-shaped; short lateral prolongations; short medial development on anterior margin. Anterior sclerite with weakly sclerotized ventral margin, narrow, finely wrinkled, laterally setose. Antrum very large, heavily sclerotized, pouch-shaped, slightly waisted posteriorly; dorsal part posteriorly broadly rounded, with margin ventrally recurved at junction with anterior margin of posterior sclerite; anteriorly with strong dorsal reflexion; ventral part with irregular transverse and oblique creases, especially on raised margins of aperture of ductus seminalis about mid-way, these creases and those at junction with sclerotized raised base of ductus bursae making antrum asymmetrical. Ductus bursae minutely spinose along entire length. Corpus bursae globular, with very minute paired denticulate areas.

REMARKS. This species is closely related to *V. suradeva*. It differs externally by the restricted pale markings and the complete black subbasal fascia of the fore wing, and by the appreciable posterior tapering of the terminal band of the hind wing. The ♂ genitalia are very similar to those of *V. suradeva*, but differ in the larger cornuti clusters and the narrower longitudinal element of the clasper. The ♀ genitalia differ in the generally larger, broader antrum and in the reflexion of its anterior margin. This species bears a superficial resemblance to some members of the *stettina*- and *pyraliata*-groups; the ♀, with extra white markings of the fore wing postmedial fascia, closely resembles *V. muluana*. However, *V. teleroma* is distinguishable from all these by the genital

characters of the species groups (see diagnoses of *stettina*-group, p. 286, *pyraliata*-group, p. 303, *suradeva*-group, p. 317).

BIOLOGY. Early stages and host-plant unknown. Moths collected in March, May, June, September and October.

DISTRIBUTION (Fig. 23). Malaya; Sumatra; Natuna Island; Borneo. Dubious records from Sri Lanka, India: Darjiling.

MATERIAL EXAMINED

Paralectotypes. **Malaya:** 1 ♂, Perak, 6844 (genitalia slide no. 15845; BMNH). **Borneo:** 1 ♂, 2 ♀, no data, Moore coll. (genitalia slide no.'s 8263, 15850; BMNH). [1 ♀, Kalao Is., see under *Vitessa plumosa plumosa* Hampson.]

Malaya: 1 ♂, Pulo Pinang ('Penang Island'), ex Boisduval coll. (BMNH); 1 ♂, 1 ♀, Penang, 1896 (*Curtis*) (BMNH); 5 ♂, Penang (BMNH; CMAG, Birmingham, UM, Oxford; MM, Manchester); 3 ♂, Penang, Government Hill, 300 m, v.1898 (*Curtis*) (BMNH); 1 ♂, Penang Hill, ix.1932 (*Corbet*) (BMNH); 3 ♂, Fraser Hill, x.1930 (*Corbet*) (BMNH); 5 ♂, Bukit Kutu, 1000 m (*Sanderson*) (BMNH); 1 ♂, Kutu Hill, 1050 m, iii.1931 (*Corbet*) (BMNH); 4 ♂, Wellesley Province (*Distant*) (TM, Pretoria). **Sumatra:** 2 ♂, SW. Sumatra, N. Korintji Valley, 1500 m, ix–x.1921 (*Pratt*) (TM, Pretoria); 1 ♂, no exact data, Adams Bequest (BMNH). **Natuna Island:** 1 ♂, Bunguran, vii–x.1894 (*Hose*) (BMNH). **Borneo:** 1 ♀, Kalimantan, Island of Pontianak, Sintang, xii.1909 (*Martin*) (BMNH); 1 ♀, K., Samarinda, ix.1938 (*Walsh*) (BMNH); 2 ♀, no exact data (BMNH; CAS, San Francisco); 1 ♂, Sarawak, Matang, 1100 m, vi.1900 (*Shelford*) (BMNH); 4 ♂, S., Gunong Mulu Nat. Park, Mulu, 1790 m, lower montane (moss) forest, MV – canopy, i.1978 (*Holloway et al.*) (BMNH); 1 ♂, S., Gunong Mulu Nat. Park, G. Api, 1500 m, scrub, pandanus, Act. iv.1978 (*Holloway et al.*) (BMNH). No data: 1 ♂, 1 ♀, ex Felder coll. (BMNH); 1 ♂, ex Joicey coll. (BMNH); 1 ♂ (UZM, Copenhagen). Dubious data: 1 ♀, Ceylon (*Niet.*) ex Felder coll. (BMNH); 1 ♂, Darjeeling (BMNH).

Vitessa suradeva Moore, [1860]

(Figs 24, 32, 40, 131–134, 171, 172, 202, 203, 218, 267, 268, 313, 314)

Vitessa suradeva Moore, [1860] : 299.

♂, ♀. 30–54 mm. Frons, vertex orange. Eye, ocellus brown. Chaetosema with pale yellowish setae. Antenna black, anterior surface of scape basally orange; dorsal scaling of apical third of shaft white, extending to nearly half length of shaft in ♀, last several segments fuscous. Labial palpus: first two segments orange, third segment black, sometimes minutely tipped with white. Maxillary palpus basally black, distally orange. Basal scaling of proboscis blue-black, ventrally admixed with orange. Neck region orange. Thorax above: large medial black oval spot, anteriorly and laterally orange, posteriorly white; patagium orange with posteromedial glossy blue-black spot; tegula orange, anterolateral glossy blue-black spot, tip black. Abdomen above: black, posterior margins of segments white, widest on second segment, progressively narrowing, terminal segment with posterior margin and anal tuft orange. Body below blue-black; pectus orange; abdomen as above from second segment on, white margins broader. Legs black; fore coxa dorsally orange, tipped with black, ventrally white; mid and hind coxae banded with white; fore femur ventrally orange, mid and hind femora ventrally white; mid and hind tibiae with broad medial white band; tibiae posteriorly tipped with white; tibial spurs white, admixed with black in ♀; all first tarsal segments bearing posterior dorsal white spot. Fore wing above: ground-colour blue-black, dark green hue along costa. Basal orange area narrowly subcostal, extending to posterior margin, white at base; orange subcostal and *CuP* streaks to base, demarcating anterior round basal black dot, posterior oblique basal black streak, the latter reaching posterior margin; orange medial margin with *CuP* streak joining white antemedial fascia, anterior and posterior margins basally arcuate, narrowly short of white fascia at costa, becoming white and extending along posterior margin to antemedial and postmedial fasciae; glossy blue-black subbasal fascia demarcated and divided into two quadrate spots by orange streak, anterior spot to costa, posterior spot short of posterior margin. Greyish white antemedial fascia narrowly short of costa, basal margin slightly arcuate anterior and posterior to *CuP*; medial margin broadly indented at cell, a triangular streak on either side, short of or touching white postmedial fascia; greyish white postmedial fascia divided into two major spots at *Cu*₂, or diffusely joined at this point in ♀, anterior spot large, oval, over discocellular vein, short of costa, posterior spot irregular, more distal in ♀, sometimes divided at *Cu*₂ and *A*₁ in ♂, large central portion medially extended on *CuP* and sometimes touching antemedial fascia. Terminal area with greyish white on all veins, always thin or greatly reduced on *CuP*, short of or touching termen,

sometimes joining posterior spot of postmedial fascia on Cu_1 and Cu_2 ; fringe light grey, sometimes admixed with white at apex. Hind wing above: costal infuscation narrow, black terminal band violaceous, broad at apex, tapering very weakly and gradually towards anal margin; large medial white area broadly extending to anal margin; fringe basally light grey, distally white. Fore wing below: black, slightly violaceous, particularly anterior to cell, brownish fuscous in cubital region, broadly white along posterior margin; short subcostal white streak at base; retinaculum whitish grey; white postmedial fascia a long narrow oval in ♂, divided at Cu_2 in ♀; short, greyish white apical and terminal vein-lines to Cu_2 in ♀, only short faint apical lines in ♂; fringe light grey in ♂, basally white in ♀. Hind wing below as above; costa broadly edged with white; short faint apical and terminal white vein-lines to Cu_2 ; fringe white.

GENITALIA ♂ (Figs 32, 40, 171, 172, 202, 203, 218). Generally as described for *V. teleroma*. Base of uncus very wide, flattened and laterally constricted. Valve with costa incurved for most of length, apex sharply subtruncate, posteroventral angle broadly rounded; basal portion of clasper joining raised rim of scoop-shaped process, distal portion tubular and tapering, running parallel to posterior margin; catena (Fig. 40) on anellus (Figs 202, 203) constricted at base and distally; cornuti clusters (Fig. 218) variable in length.

GENITALIA ♀ (Figs 267, 268, 313, 314). Generally as described for *V. teleroma*. Antrum (Figs 313, 314) very large, heavily sclerotized, pouch- or sack-shaped, slightly waisted medially or tapering anteriorly, roughly square or noticeably longer than wide; anteriorly with slight dorsal reflexion; ventral wall with strong oblique creases giving rise to sclerotized base of ductus seminalis at mid-length, these creases producing slight asymmetry of antrum.

REMARKS. This species is distinguished by the strong division of the blue-black subbasal fascia of the fore wing by an orange streak on CuP joining the orange basal area to the white antemedial fascia; and by the presence of two distinctly demarcated blue-black basal spots. The white fasciae of the fore wing are basically similar to those of other groups where these markings are extensive and the fasciae more or less complete. The basal and subbasal dark markings most closely resemble those in *V. hieratica*, but here the division and demarcation of the spots is less complete; the white fasciae most closely resemble those in *V. plumosa*, but in that species the medial streaking of the antemedial fascia is more accentuated than in *V. suradeva*. The genitalia closely resemble those of *V. teleroma*; the ♂ genitalia are distinguished by the generally wider base of the uncus, the incurved costa, the general shape of valve, the slightly wider ridge of the distal portion of the clasper and its complete joining to the base of the ridge; in the ♀ genitalia by the distinctly longer antrum and weaker dorsal reflexion, and by the origin of the ductus seminalis mid-way on the antrum. We recognize two subspecies, from the following geographical areas: (1) north India, W. Bengal and Assam; Bangladesh; Burma; Thailand and Vietnam; (2) southern India and Sri Lanka. These have been considered distinct species by some authors, synonyms by others.

BIOLOGY. Early stages and host-plant information given under *V. suradeva rama*, below. Moths collected by various collectors throughout the year.

DISTRIBUTION (Fig. 24). Sri Lanka; India; Bangladesh; Burma; Thailand; Vietnam.

***Vitessa suradeva suradeva* Moore, [1860]**
(Figs 24, 40, 131, 132, 171, 202, 267, 313)

Vitessa suradeva Moore, [1860], in Horsfield & Moore, *Cat. lepid. Insects Mus. nat. Hist. East-India House* 2 : 299, pl. 7a, fig. 7; Lederer, 1863 : 335, pl. 6, fig. 6; Walker, 1864 : 219; Moore, 1886 : 58; Swinhoe & Coates, 1889 : 664; Swinhoe, 1890 : 292; Snellen, 1890 : 560; Ragonot, 1891 : 110; Swinhoe, 1900 : 429. **LECTOTYPE** ♂, INDIA: Assam, Chera Poonjee ('Cherrapunji') (*Buckley*) (Type no. 2637; genitalia slide no. Oxford 718-1977, Shaffer; UM, Oxford), here designated [examined].

Vitessa formosa Felder & Rogenhofer, 1874, *Reise öst. Fregatte Novara*, Zool. Theil, 2: pl. 137, fig. 1. Holotype ♀, INDIA ('Ind. or.') (genitalia slide no. 16021; BMNH) [examined]. [Synonymized by Hampson, 1896a : 146.]

Vitessa suradeva Moore; Hampson, 1896a : 146; 1896b : 503, partim.

[*Vitessa suradeva* Moore; Kenrick, 1907 : 75. Misidentification: see *Vitessa hemiallactis hemiallactis* Meyrick, above.]

[*Cosmethis suradeva* (Moore); Janse, 1928 : 88. Misidentification: see *Vitessa hollandi hollandi* subsp. n., above.]

Cosmethis suradeva (Moore); de Joannis, 1930 : 637.

♂, ♀. 40–54 mm. As described for species.

GENITALIA ♂ (Figs 40, 171, 202). Generally as described for *V. teleroma* and *V. suradeva*. Base of uncus very wide above lateral constriction. Scoop-shaped process on clasper very large, usually exceeding posterior margin. Left cornuti cluster about two and a half times length of right.

GENITALIA ♀ (Figs 267, 313). Generally as described for *V. teleroma* and *V. suradeva*. Antrum (Fig. 313) very large, roughly square, pouch-shaped, slightly waisted medially; posterior margin of dorsal wall medially convex, recurved, covering opening to antrum; deep, oblique, longitudinal and transverse folds on ventral wall giving rise to raised sclerotized base of ductus seminalis at about mid-length; lower third of antrum with slight dorsal reflexion; posteriorly produced, narrowed and convex beyond broad-shouldered entry of ductus bursae; reflexion and creases causing asymmetry of antrum.

REMARKS (see also Remarks under species). Apart from being generally larger than *V. suradeva rama* and having a somewhat more finely tapering terminal band on the hind wing, this subspecies is indistinguishable externally. The genitalia, however, are distinct in both sexes. The ♂ genitalia have the base of the uncus slightly broader, the costal margin of the valve more strongly curved, the scoop-shaped process of the clasper larger, and the cornuti clusters proportionally larger. In the ♀ genitalia the antrum is more distinctly pouch-shaped, wider but shorter, with a more noticeable dorsal reflexion, and with generally even width.

BIOLOGY. Early stages and host-plant unknown. Moths collected from February to May, August to October and December.

DISTRIBUTION (Fig. 24). Northern India; Bangladesh; Burma; Thailand; Vietnam.

MATERIAL EXAMINED

Paralectotypes. **India:** 1 ♂ (*Argent*) (Type no. 2637; UM, Oxford). [There were originally two more syntypes, one collected by Buckley, one by Argent. These have not been traced; they may be among the material listed below, but we have not been able to establish this.]

India: 1 ♂, Malnold [?] [with label citing original reference for *V. suradeva*], ex Felder coll. (BMNH); 1 ♀, no exact data, ex Felder coll. (BMNH); 2 ♂, 1 ♀, no exact data, ex Swinhoe coll. (TM, Pretoria); 1 ♀, no exact data (TM, Pretoria); 1 ♀, no exact data (*Elwes*) (RNH, Leiden); 1 ♀, Darjeeling, Gopaldhara, 1400 m (*Stevens*) (BMNH); 3 ♀, Darjiling, viii.1912 (*Carmichael*) (UM, Oxford); 3 ♀, Darjiling (*Carmichael*) (RSM, Edinburgh); 1 ♂, 27 ♀, Darjiling (*Möller*) (BMNH); 1 ♂, Darjeeling, v.1935 (*Sevastopulo*) (BMNH); 3 ♂, 5 ♀, Darjiling (BMNH); 1 ♂, 1 ♀, Khasi Hills, Moore coll. (BMNH); 14 ♂, 4 ♀, Khasis, ix–x.1894 (CMAG, Birmingham; MNHN, Paris; UM, Oxford); 3 ♀, Khasi Hill[s], iii, v, vi.1973 (HI, Irua City); 21 ♂, 19 ♀, Assam, Khasia Hills [1 ♂, ix.1894] (BMNH; NMNH, Washington; TM, Pretoria; UM, Oxford); 1 ♂, Khasis [*sic*] Hills (*Hamilton*) (BMNH); 2 ♀, Assam, Cherrapunji, v.1893 (*C. F. H.*) (BMNH); 3 ♂, Assam (BMNH; NMNH, Washington); 1 ♂, Assam, Jaintia Hills (MM, Manchester); 1 ♂, Cachar (UM, Oxford); 1 ♂, Naga H[ills] (BMNH). **Bangladesh:** 2 ♂, 2 ♀, Sylhet (UM, Oxford); 3 ♂, 1 ♀, Sylhet (BMNH). **Burma:** 1 ♀, no exact data (TM, Pretoria); 4 ♀, East Pegu, 1200–1500 m, iii–iv.1890 (*Doherty*) (BMNH); 1 ♀, Mergui, [xii, (*Anderson*),] ex Moore coll. (BMNH); 5 ♂, Mergui (*Doherty*) (TM, Pretoria). **Thailand:** 1 ♀, Khao Sabap, Chentaban, 1935 (*Macbeth*) (BMNH); 1 ♂, Pyayen Range, Pakchong, xii.1957 (*Munroe*) (CNC, Ottawa). **Vietnam:** 2 ♂, Tonkin, Cha pa, ii.1930 (*Lemai*) (MNHN, Paris); 1 ♂, Tonkin, Son La (*Lemai*) (MNHN, Paris); 1 ♀, Tonkin (MNHN, Paris); 1 ♂, 2 ♀, Hanoi [(*Lerminat*)] (MNHN, Paris); 1 ♀, Cochinchina [?], Laokai, vi.1936 (*Massejeyff*) (BMNH); 1 ♂, Haut Donai, E. Poilane (NMNH, Washington). No data: 6 ♂, 2 ♀, (BMNH; NMNH, Washington; UM, Oxford).

Vitessa suradeva rama Moore, 1885, stat. n.
(Figs 24, 32, 133, 134, 172, 203, 218, 268, 314)

Vitessa rama Moore, 1885, *Lepid. Ceylon* 3 : 256, pl. 178, fig. 4. LECTOTYPE ♂, SRI LANKA ('Ceylon'): Moore coll. 94-106 (BMNH), here designated [examined].

♂, ♀. 30–50 mm. As described for species.

GENITALIA ♂ (Figs 32, 172, 203, 218). Generally as described for *V. teleroma* and *V. suradeva*. Left cornuti cluster (Fig. 218) over three times length of right. See also Remarks, below.

GENITALIA ♀ (Figs 268, 314). Generally as described for *V. teleroma* and *V. suradeva*. Antrum (Fig. 314) very large, sack-shaped, posteriorly wide, gradually tapering anteriorly, distinctly longer than wide. Posterior margin of dorsal wall medially with broadly conical recurved flap, covering opening to antrum; about lower third of antrum with very slight dorsal curve, not causing reflexion; anteriorly narrowly rounded, tip level with opening of ductus bursae; deep, oblique longitudinal and transverse folds on ventral wall giving rise to raised sclerotized base of ductus seminalis, opening posterior to mid-length of antrum; creases causing only slight asymmetry of antrum.

REMARKS. This has often been treated as a distinct species, but the differences from *V. suradeva suradeva* are small, and we consider them as of subspecific value only. This subspecies is on the average smaller than the nominate subspecies, but the measurements given include a series bred in southern India by T. R. Bell; this series contains most of the smallest specimens. The pale markings of the fore wing are very slightly reduced and the black terminal band of the hind wing is generally broader in *V. suradeva rama* than in *V. suradeva suradeva*, otherwise specimens of comparable size are externally indistinguishable. The ♂ genitalia of the present subspecies have the basal part of the uncus slightly narrower, the valve slightly narrower, with a smaller scoop-shaped process on the clasper and, as the most striking feature, the right cornuti cluster much reduced. The ♀ genitalia are distinct by the shape and size of the antrum, which in the present subspecies is larger, narrower and generally shows little sign of dorsal reflexion.

BIOLOGY. The description of immature stages is adapted from the manuscript notes of T. R. Bell preserved in the British Museum (Natural History). Cast larval skins and pupal cases, included with material from south India in the Bell collection, have been examined for comparison with Bell's descriptions. The terminology used here for larval characters is mainly based on Peterson (1962), that for pupal characters on Kuznetsov (1967); the setal nomenclature of the larva and any ambiguous terms follow Bell's own system.

LARVA. Length 35–40 mm; width, middle of body 4.5 mm, head 3.5 mm. Oily-looking; general coloration glossy black with white and orange markings. Head-capsule light orange, broadly semi-oval, surface glossy and smooth. Tubercles wider than setae they bear, circular, not prominent; setae fine; subdorsal setae near apex of front nearly as long as height of head, those of adfrontals shortest, not as long as width of front. Front equilaterally triangular, apex widely arched, each side slightly incurved, reaching more than one-third height of head. Adfrontals half height of head, apex more broadly arched, the whole not clearly defined. Clypeus transverse, transparent or nearly so, posterior margin strongly curved, anterior margin quite straight. Labrum glossy, blackish and kidney-shaped, as long as but narrower than clypeus. Basal segment of antenna orange, second and third segments glossy black. Mandible black, cutting edge entire or nearly so. Six ocelli arranged in a semicircle, of equal size, three, four and six black, remainder yellow with black centres. Legs long, glossy, black, claw rose-tinged. Prolegs thin, held well under abdomen, with infuscated glassy-colourless cylindrical shanks and light coloured planta bearing crochets in complete circle. Strongly interrupted subspiracular white line running whole length of thoracic and abdominal segments; below, an interrupted line of similar spots along the line of legs. White spots on mesothorax and first abdominal segment larger than rest and nearly coalescent to form a short subdorsal line. A supraspiracular, interrupted, white, longitudinal line or narrow band from first to eighth abdominal segments, formed of three spots and lines on each segment. Seventh abdominal segment longer than eighth; eighth segment contracted posteriorly by deeply impressed line, widely convex anteriorly from spiracle to spiracle, dividing off nearly one-third of segment which is twice as long as ninth, appearing somewhat tumid medially; ninth segment with posterior margin shelving shortly to tenth. Ninth segment black; tenth segment, including anal claspers, orange; claspers short, erect, bases thickly conical, ends broadly rounded, planta light orange, two-lobed, with crochets arranged in straight row. Ventral surface of body black. Spiracles broadly oval, reddish brown, with coarse, raised, glossy, black rims; those of prothorax and eighth abdominal segment fully twice as wide and long as any other; those from first to third segments slightly larger than spiracles from fourth to seventh, which are about one-sixteenth as long as segment. Setae white, arising from black tubercles, erect, fine, as long as width of body. Setae of all subspiracular tubercles, especially on ninth and tenth abdominal segments, as long as a segment, subdorsals and dorsolaterals a little over half as long. Setal arrangement of fifth abdominal segment: dorsal

trapezoidal arrangement of setae one-third length of segment; subdorsals the same distance apart; dorso-laterals very little more; supraspiracular a spiracle length in front of and above spiracle; two sub-spiraculars close together and with no postspiracular setae, a little less than three spiracle lengths below spiracle, one being directly below spiracle, the other a spiracle length in front of first and slightly higher up; of five others, one behind and below the subspiraculars and four on the leg-base.

PUPA. Length 16 mm, width 6 mm. Glossy; dorsally bright orange-chestnut, ventrally lighter. Stout, widest at centre, anteriorly conical, head anteriorly square; abdomen weakly tapering posteriorly, sharply tapering from seventh segment, anal end narrowly rounded. Surfaces of head and thoracic areas minutely corrugated; surfaces of first to eighth abdominal segments minutely pitted, posterior margins of segments, especially of seven and eight, broadly smooth and without pits; segments nine and ten without pits. Dorsal surface: areas well demarcated except between mesonotum and fore wings, metanotum and hind wings; hind wings narrowly visible to past centre of third tergite; fore wings visible to near centre of fourth. Line of fore wing straight on narrow convergence to anterior end of metanotum; anterior margin of metanotum broadly concave. Abdominal tergites two and three noticeably wider than remainder. Spiracles from tergites two to eight with raised dark rims, those of tergites two, three and eight noticeably larger than remainder. Ventral surface; tips of fore wings medially reaching fifth sternite; antennae converging with mid and hind legs, with tips raised from surface, reaching sternite six. Cremaster composed of eight hooks, two central hooks stouter and larger.

HABITS. Larvae communal when young, up to six together in a clean, clear, laxly woven web spun on undersides of young leaves; separating when fully grown, each making a similar web for itself amongst older leaves towards the tops of the plants; preferring to feed on young leaves throughout their existence. Often found sitting highly looped like a semilooper of the noctuid type. Larvae active and moving about the web with alacrity but rarely leaving it. When ready to pupate, larvae descending to ground and making a cocoon of paper-like consistency with light fawn-coloured silk, shining smooth inside and more fluffy outside. Cocoon made against the side of a stone just under the surface of the earth or in a similar place; nearly circular or broadly oval and slightly pointed at the ends; attached by threads of silk all round. Outer threads made first, the larva then retiring into the middle and making the cocoon proper. The latter very roomy, measuring 23 mm × 10 mm × 5 mm. Pupa attached inside by cremaster; imago emerging through a slit at other end. Moth flying by day, seen at Castle Rock at 1500 ft [450 m] in September, feeding from flowers of a large tree called Kadam tree (Rubiaceae), relatively few *V. suradeva* in the company of large numbers of *Macrobrochis gigas* (Walker) (Hypsidae). Pupa described about 20.viii and the first moth emergence on the night of 13.ix.

HOST PLANT OF LARVA. This is a shrub that in Kanara only grows in the evergreen jungles on the Western Ghats but is otherwise widely distributed throughout India and Sri Lanka to Sumatra. It is a small tree, practically a shrub, that grows in the underwood, often forming nearly the whole underwood in parts. The plant is *Chailletia sumatrana* Miquel [= *Dichapetalum gelonioides gelonioides* (Beddome) Engler (Dichapetalaceae)].

GENERAL. Moths collected by various collectors in most months of the year.

DISTRIBUTION (Fig. 24). Sri Lanka; southern India.

MATERIAL EXAMINED

Paralectotypes. **Sri Lanka:** 4 ♂, 1 ♀, data as lectotype (genitalia slide no.'s 1501 [abdomen only, genitalia missing], 1502, 15855; BMNH).

Sri Lanka: 5 ♂, 12 ♀, no exact data (BMNH; CAS, San Francisco; MM, Manchester); 2 ♀, Kandy, 1886 (BMNH); 2 ♂, 2 ♀, Kandy, ix.1902–xii.1909 (*Mackwood*) (BMNH); 1 ♀, Kandy, ix.1914 (*V. H.*) (BMNH); 1 ♂, Dambulla, vii.1903 (*Newman*) (BMNH); 1 ♀, Maskeliya, vii.1885 (BMNH); 2 ♂, 7 ♀, Maskeliya, i–ix (*Mackwood*) (BMNH); 2 ♀, Pundaluoya, xi.1903 (BMNH); 1 ♂, 1 ♀, Ellahara, vii.1903 (*Newman*) (BMNH); 3 ♂, Nalanda, vii.1903 (*Newman*) (BMNH); 1 ♀, no data (*Thwaites*) (UM, Oxford); 1 ♀, no data (UM, Oxford). **India:** 1 ♀, Mui, v.1912 (*Maxwell*) (BMNH); 1 ♂, Tranvancore (*Place*) (BMNH); 1 ♀, Annamali ('Anaimalai') Hills (*Godman*) (BMNH); 1 ♂, Karwar, rains (*Davidson*) (BMNH); 8 ♂, 15 ♀, Karwar, ix.1923–iv.1924 (*Bell*) (BMNH); 1 ♂, Kanara (*Bell*) (BMNH); 10 ♂, 6 ♀, Castle Rock, v–vi.1920 (*Bell*) (BMNH); 2 ♂, 1 ♀, no data (*Mackwood*) (BMNH); 2 ♂, no data (BMNH; MNHN, Paris).

Various cocoons, pupal cases and last instar larval skins, from localities in southern India (*Bell*) (BMNH).

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Figs 45–51 (45) *Vitessidia diaphana* Rothschild & Jordan, ♂, New Guinea. (46) *V. diaphana* Rothschild & Jordan, ♀, New Guinea. (47) *V. geometrina* sp. n., ♀ holotype, New Guinea. (48) *Cosmethella unipectinalis* (Hampson), ♂, Solomon Islands. (49) *C. unipectinalis* (Hampson), ♀, Solomon Islands. (50) *C. minor* sp. n., ♀ holotype, New Guinea. (51) *C. major* sp. n., ♀ holotype, New Guinea.



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Figs 52-57 (52) *Vitessa griseata* Kenrick, ♂, New Guinea. (53) *V. griseata* Kenrick, ♀, New Guinea. (54) *V. brandti* sp. n., ♂ holotype, New Britain. (55) *V. talboti* (Janse), ♂ lectotype, Moluccas. (56) *V. talboti* (Janse), ♀ paralectotype, Moluccas. (57) *V. nobilis* sp. n., ♀ holotype, Moluccas.



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Figs 58–65 (58) *Vitessa cyanea ceramensis* subsp. n., ♂ allotype, Moluccas. (59) *V. cyanea ceramensis* subsp. n., ♀ holotype, Moluccas. (60) *V. cyanea cyanea* Hampson, ♂, D'Entrecasteaux Islands. (61) *V. cyanea cyanea* Hampson, ♀, D'Entrecasteaux Islands. (62) *V. zemire expansa* subsp. n., ♂, Moluccas. (63) *V. zemire expansa* subsp. n., ♀ paratype, Moluccas. (64) *V. zemire zemire* (Stoll), ♂, Moluccas. (65) *V. zemire zemire* (Stoll), ♀, Moluccas.



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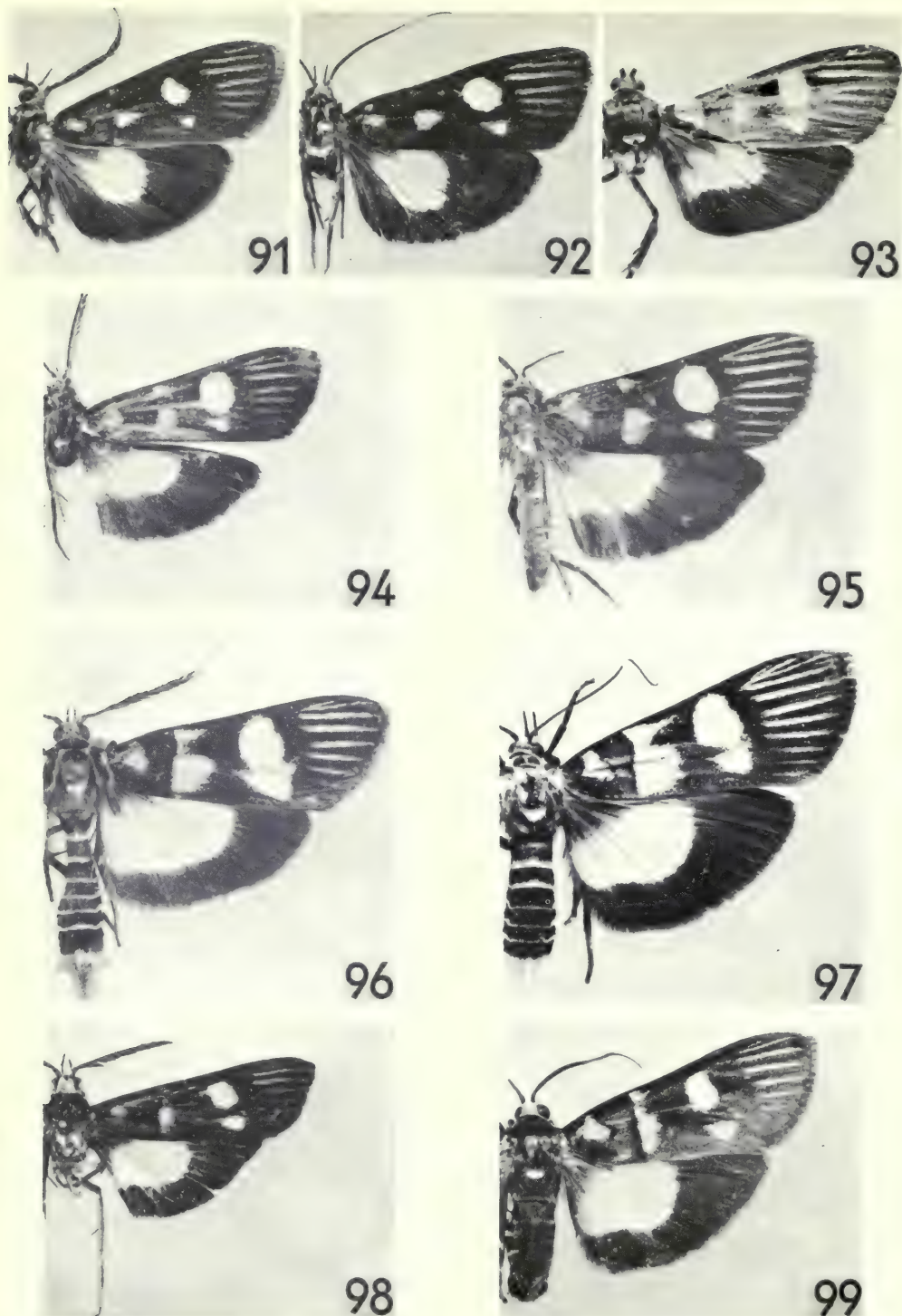
Figs 66–73 (66) *Vitessa zemire temerata* Swinhoe, ♂, New Guinea. (67) *V. zemire temerata* Swinhoe, ♀, New Guinea. (68) *V. zemire nephritica* subsp. n., ♂ paratype, Australia. (69) *V. zemire nephritica* subsp. n., ♀ paratype, Australia. (70) *V. zemire coronis* subsp. n., ♂ holotype, Umboi Island. (71) *V. zemire coronis* subsp. n., ♀ allotype, Umboi Island. (72) *V. zemire novaebritanniae* subsp. n., ♂ holotype, New Britain. (73) *V. zemire novaebritanniae* subsp. n., ♀ allotype, New Britain.



Figs 74–81 (74) *Vitessa zemire solomonis* subsp. n., ♂ holotype, Solomon Islands. (75) *V. zemire solomonis* subsp. n., ♀ paratype, Solomon Islands. (76) *V. zemire cheesmanae* subsp. n., ♂ paratype, New Hebrides. (77) *V. zemire cheesmanae* subsp. n., ♀ paratype, New Hebrides. (78) *V. vitalis* Hampson, ♂, Fiji. (79) *V. vitalis* Hampson, ♂, Fiji (Lau group). (80) *V. vitalis* Hampson, ♀, Fiji. (81) *V. tamsi* sp. n., ♀ paratype, Western Samoa.



Figs 82–90 (82) *Vitessa hieratica* Swinhoe, ♂, Borneo: Sarawak. (83) *V. hieratica* Swinhoe, ♀, Sumatra. (84) *V. philippina* sp. n., ♀ holotype, Philippines. (85) *V. stettina* Swinhoe, ♂, New Guinea. (86) *V. stettina* Swinhoe, ♀, New Guinea. (87) *V. hollandi wallacealis* subsp. n., ♂ holotype, Sulawesi. (88) *V. hollandi wallacealis* subsp. n., ♀ allotype, Sulawesi. (89) *V. hollandi hollandi* subsp. n., ♂ holotype, New Guinea. (90) *V. hollandi hollandi* subsp. n., ♀ paratype, New Guinea.



Figs 91–99 (91) *Vitessa ternatica* Lederer, ♂, New Guinea. (92) *V. ternatica* Lederer, ♀ (paralectotype of *sarumensis* Holland), Moluccas. (93) *V. sp.*, ♂, Japan [?]. (94) *V. hemiallactis moluccana* subsp. n., ♂ holotype, Moluccas. (95) *V. hemiallactis moluccana* subsp. n., ♀ allotype, Moluccas. (96) *V. hemiallactis hemiallactis* Meyrick, ♂, New Guinea. (97) *V. hemiallactis hemiallactis* Meyrick, ♀, New Guinea. (98) *V. hemiallactis admiralitatis* subsp. n., ♂ paratype, Admiralty Islands. (99) *V. hemiallactis admiralitatis* subsp. n., ♀ paratype, Admiralty Islands.



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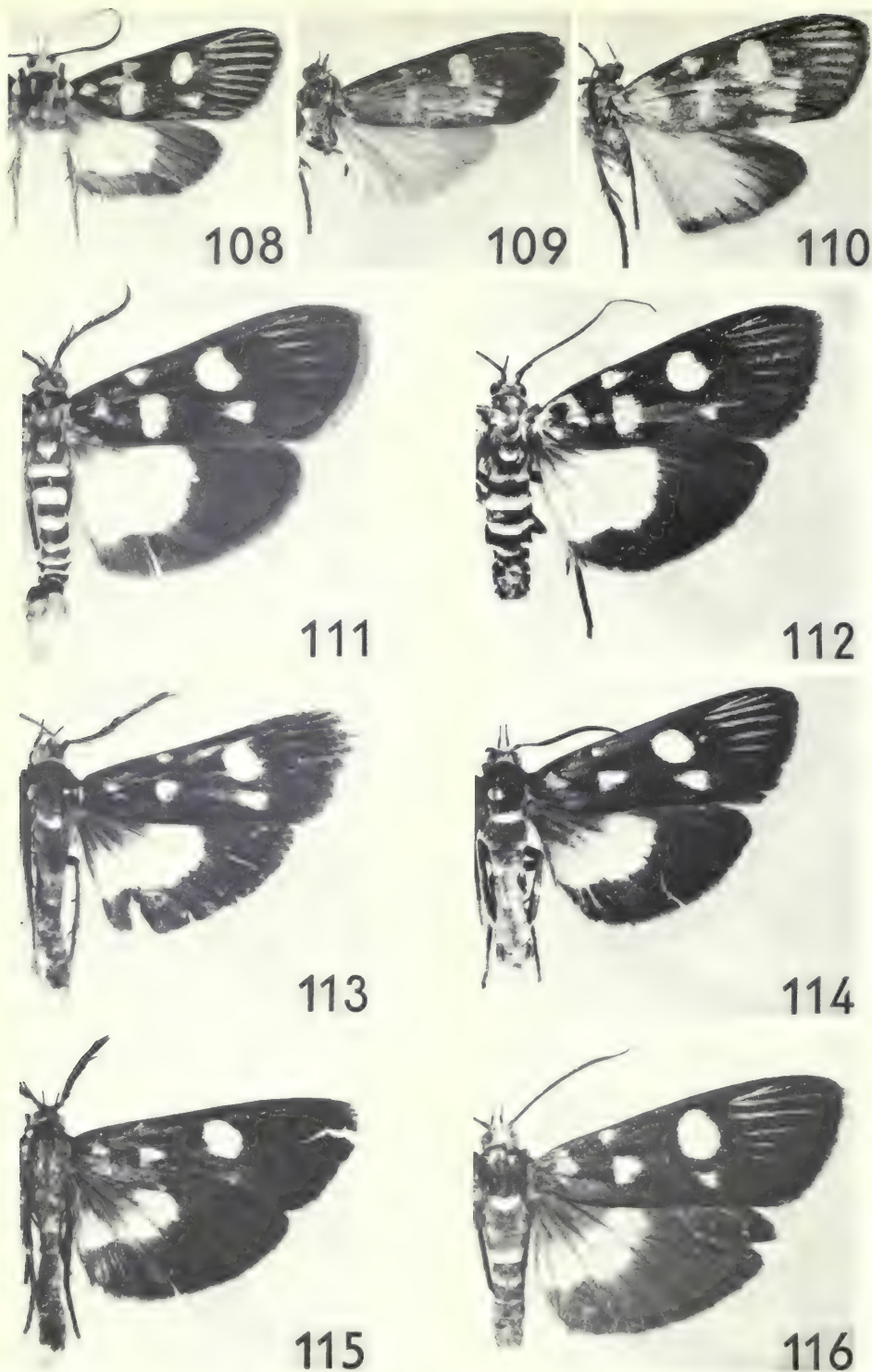


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Figs 100–107 (100) *Vitessa hemiallactis lustrans* subsp. n., ♂, New Ireland. (101) *V. hemiallactis lustrans* subsp. n., ♀ allotype, New Hannover. (102) *V. intermedia* sp. n., ♂ holotype, New Guinea. (103) *V. intermedia* sp. n., ♀ allotype, New Guinea. (104) *V. barretti* sp. n., ♂ holotype, New Guinea. (105) *V. barretti* sp. n., ♀ allotype, New Guinea. (106) *V. glaucoptera* Hampson, ♂, Australia. (107) *V. glaucoptera* Hampson, ♀, Australia.



Figs 108–116 (108) *Vitessa cristobalensis* sp. n., ♂ holotype, Solomon Islands. (109) *V. nicobarica* Hampson, ♂ paralectotype, Nicobar Islands. (110) *V. nicobarica* Hampson, ♀ paralectotype, Nicobar Islands. (111) *V. pyraliata latialbata* subsp. n., ♂ holotype, Malaya. (112) *V. pyraliata latialbata* subsp. n., ♀ paratype, Malaya. (113) *V. pyraliata triangulifera* subsp. n., ♂ holotype, Philippines. (114) *V. pyraliata triangulifera* subsp. n., ♀ paratype, Philippines. (115) *V. pyraliata pyraliata* Walker, ♂, Sulawesi. (116) *V. pyraliata pyraliata* Walker, ♀, Sulawesi.



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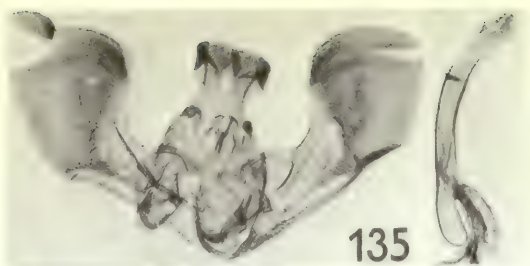


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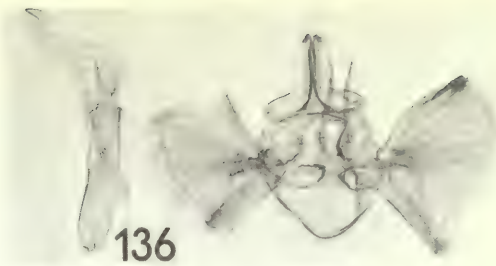
Figs 117–125 (117) *Vitessa kolakalis* sp. n., ♂ holotype, Sulawesi. (118) *V. kolakalis* sp. n., ♀ allotype, Sulawesi. (119) *V. sulaensis* sp. n., ♂ holotype, Moluccas. (120) *V. muluana* sp. n., ♀ holotype, Borneo: Sarawak. (121) *V. gemina* sp. n., ♂ holotype, Schouten Islands. (122) *V. gemina* sp. n., ♀ paratype, Schouten Islands. (123) *V. splendida* Schultze, ♂, Philippines. (124) *V. plumosa plumosa* Hampson, ♂, Lesser Sunda Islands. (125) *V. plumosa plumosa* Hampson, ♀, Lesser Sunda Islands.



Figs 126–134 (126) *Vitessa plumosa salayerensis* subsp. n., ♂ holotype, Salajar Island. (127) *V. plumosa salayerensis* subsp. n., ♀ allotype, Salajar Island. (128) *V. teleroma* Swinhoe, ♂ paralectotype, Borneo: Kalimantan. (129) *V. teleroma* Swinhoe, ♂, Malaya. (130) *V. teleroma* Swinhoe, ♀, Borneo: Kalimantan. (131) *V. suradeva suradeva* Moore, ♂, North India. (132) *V. suradeva suradeva* Moore, ♀, North India. (133) *V. suradeva rama* Moore, ♂, Sri Lanka. (134) *V. suradeva rama* Moore, ♀, South India.



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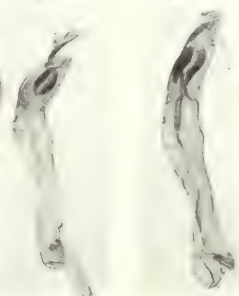
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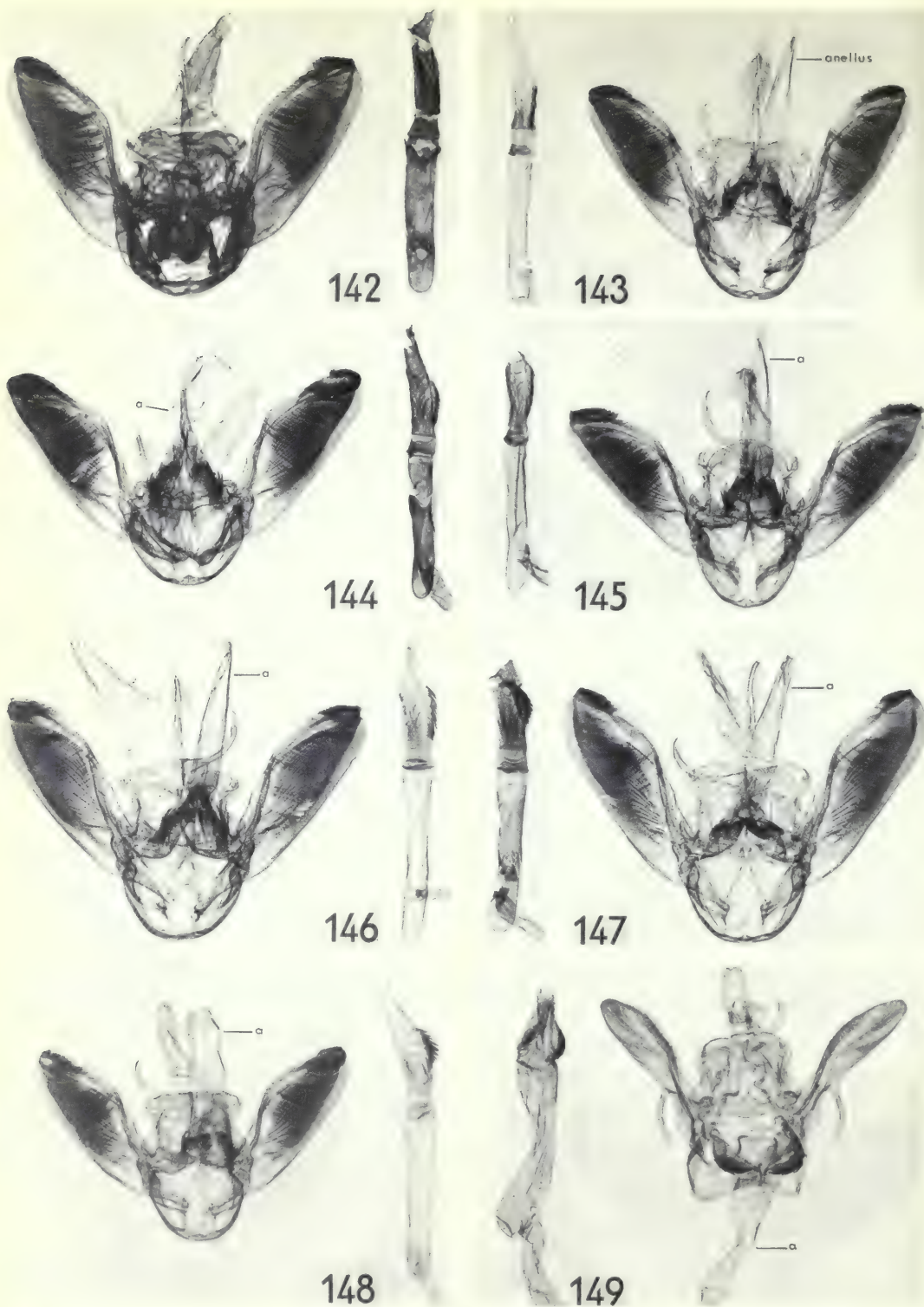


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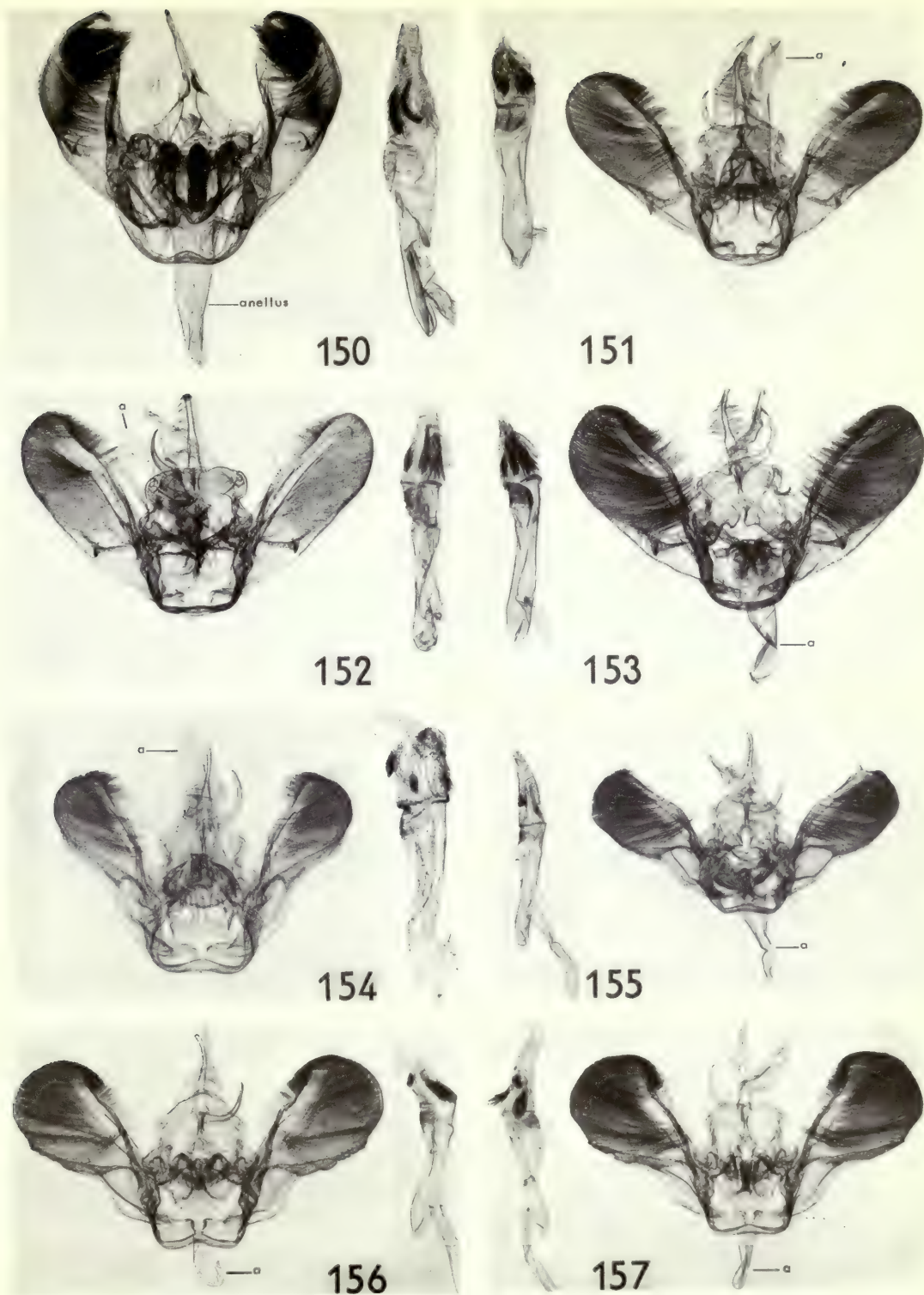


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Figs 135–141 ♂ genitalia. (135) *Vitessidia diaphana* Rothschild & Jordan. (136) *Cosmethella unipectinalis* (Hampson). (137) *Vitessa brandti* sp. n. (not to scale). (138) *V. griseata* Kenrick. (139) *V. talboti* (Janse). (140) *V. cyanea ceramensis* subsp. n. (141) *V. cyanea cyanea* Hampson.



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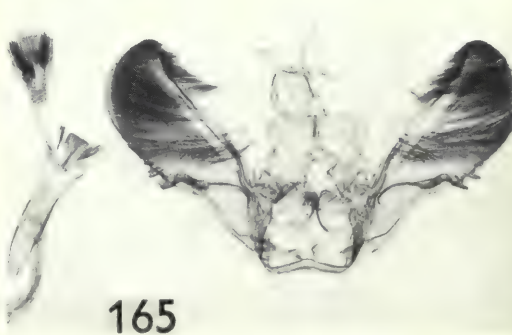
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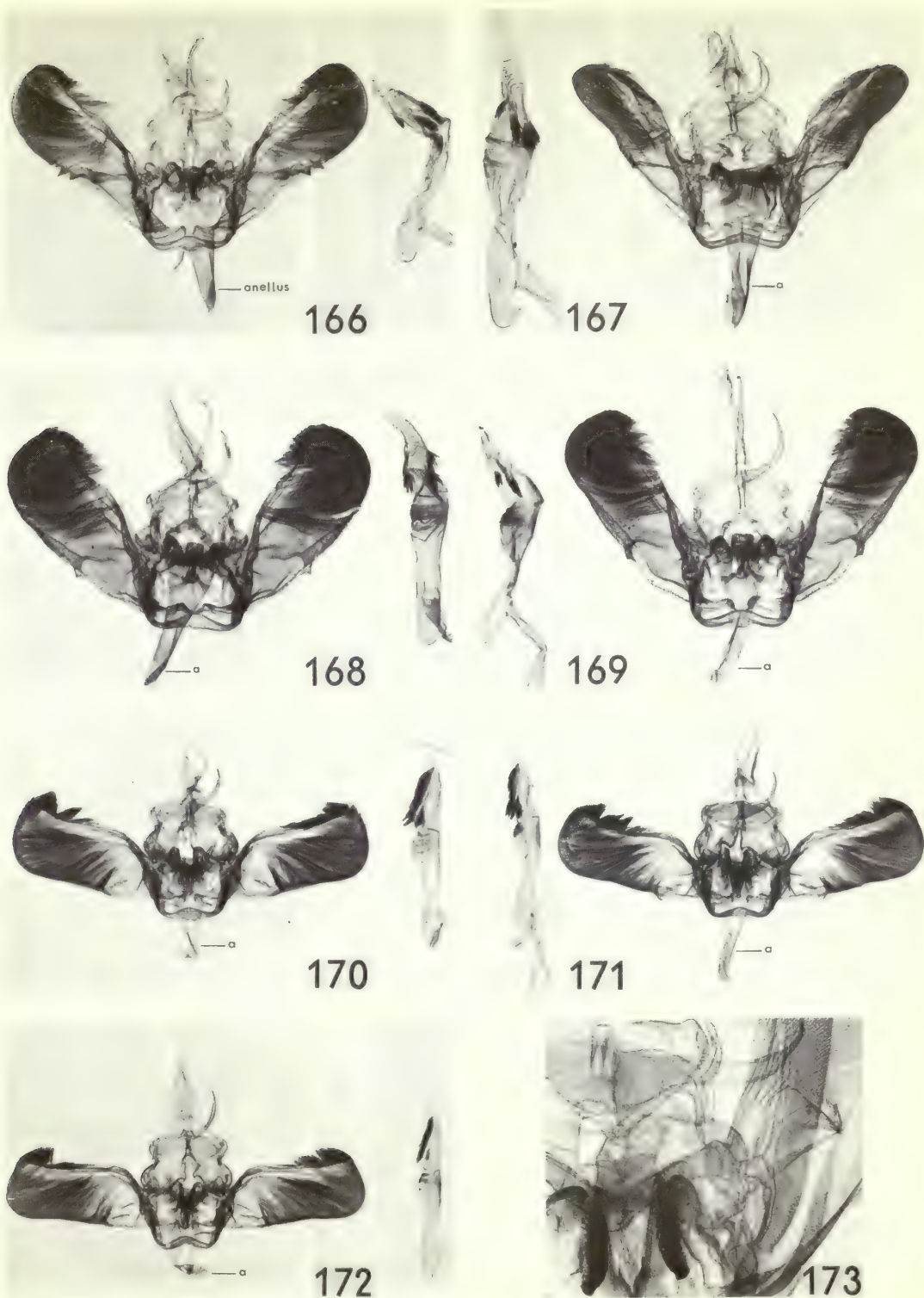


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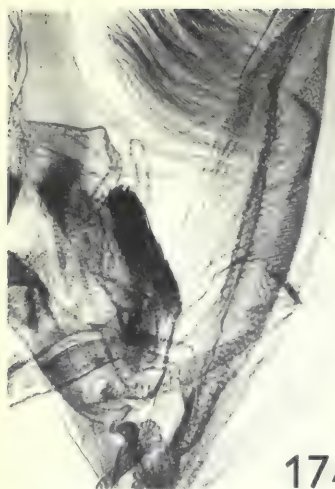


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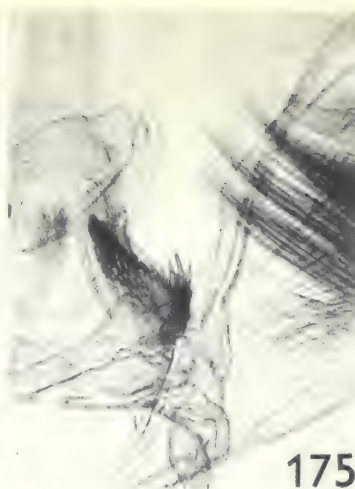
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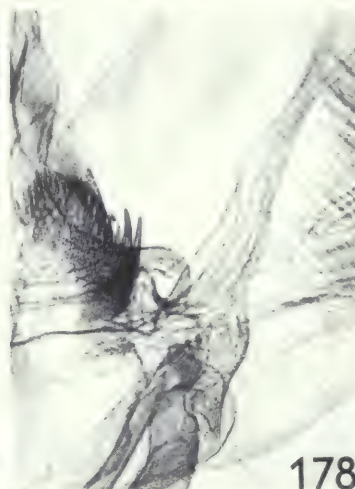
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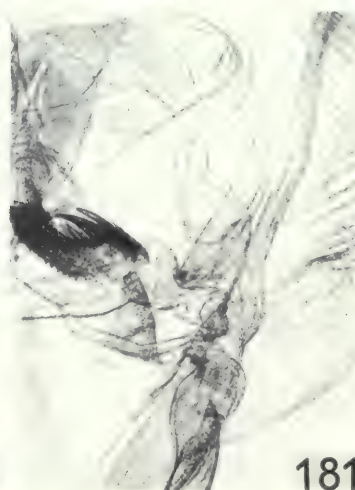
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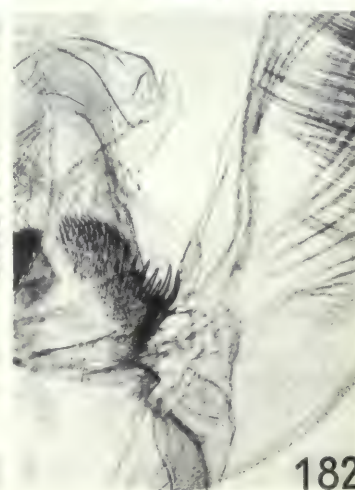
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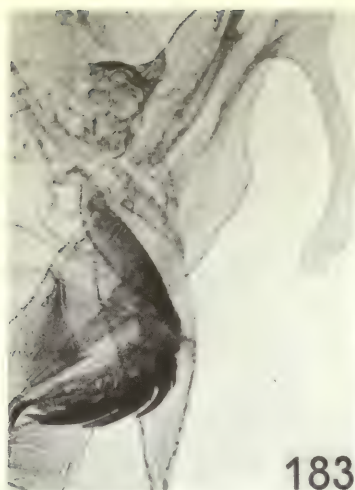


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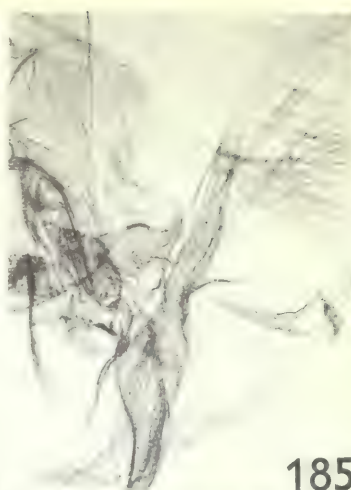
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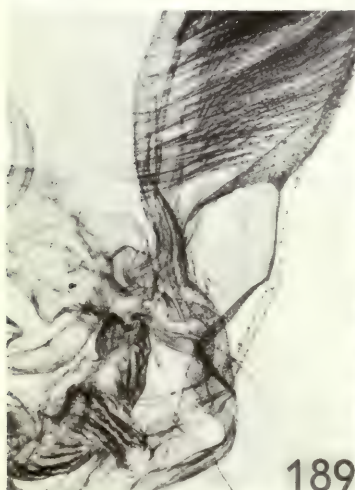
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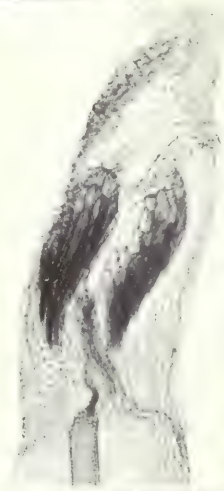
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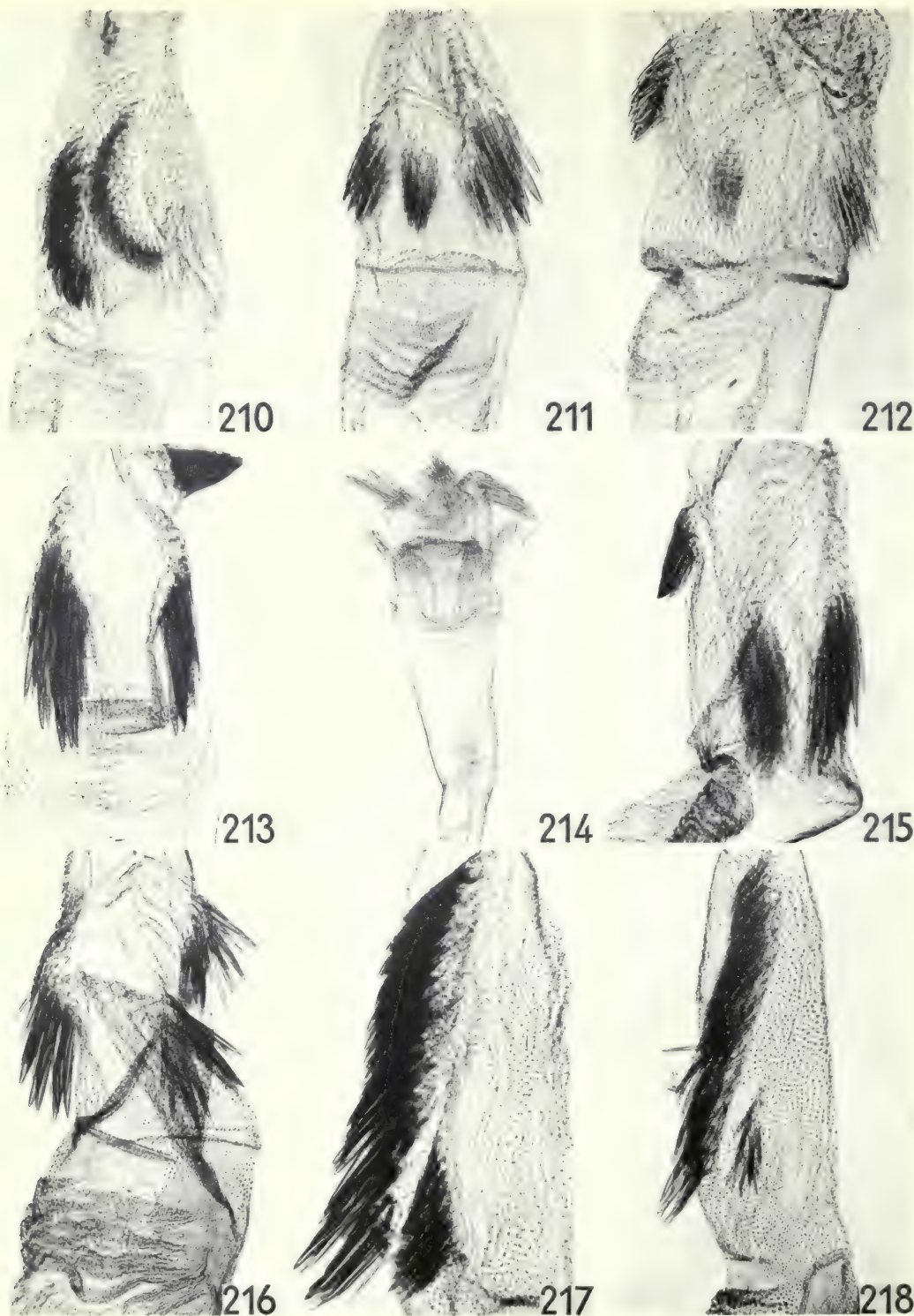


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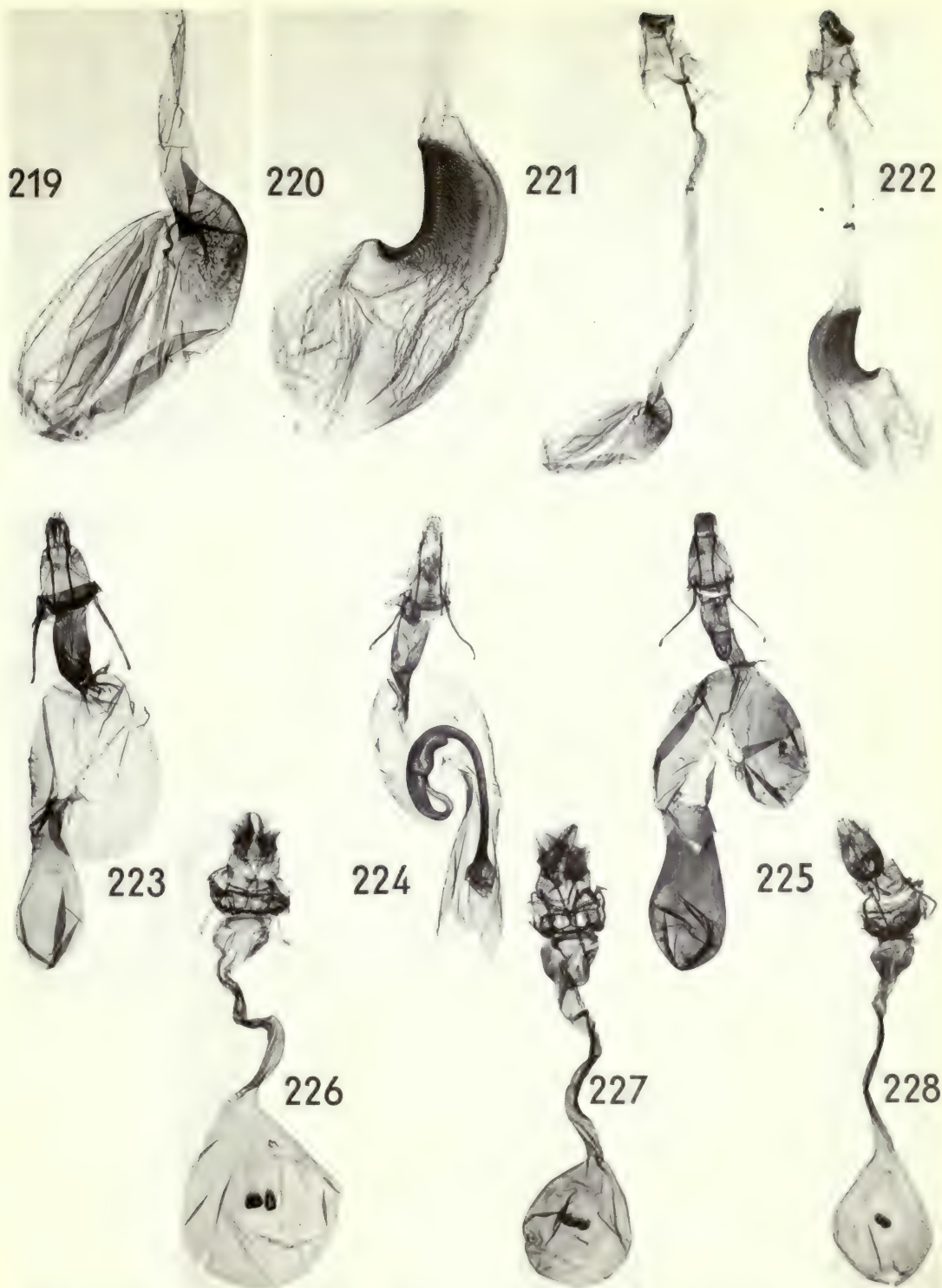


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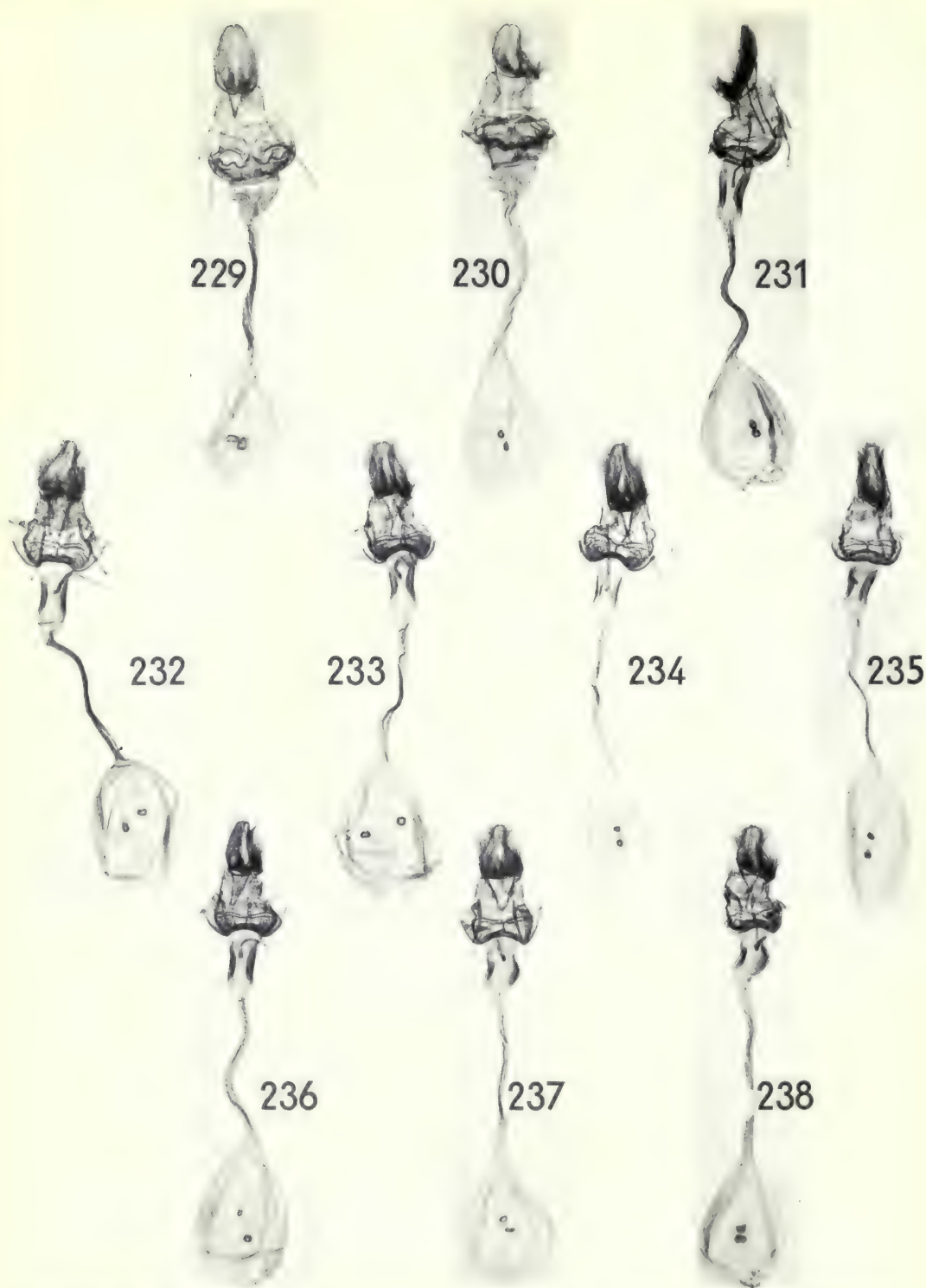
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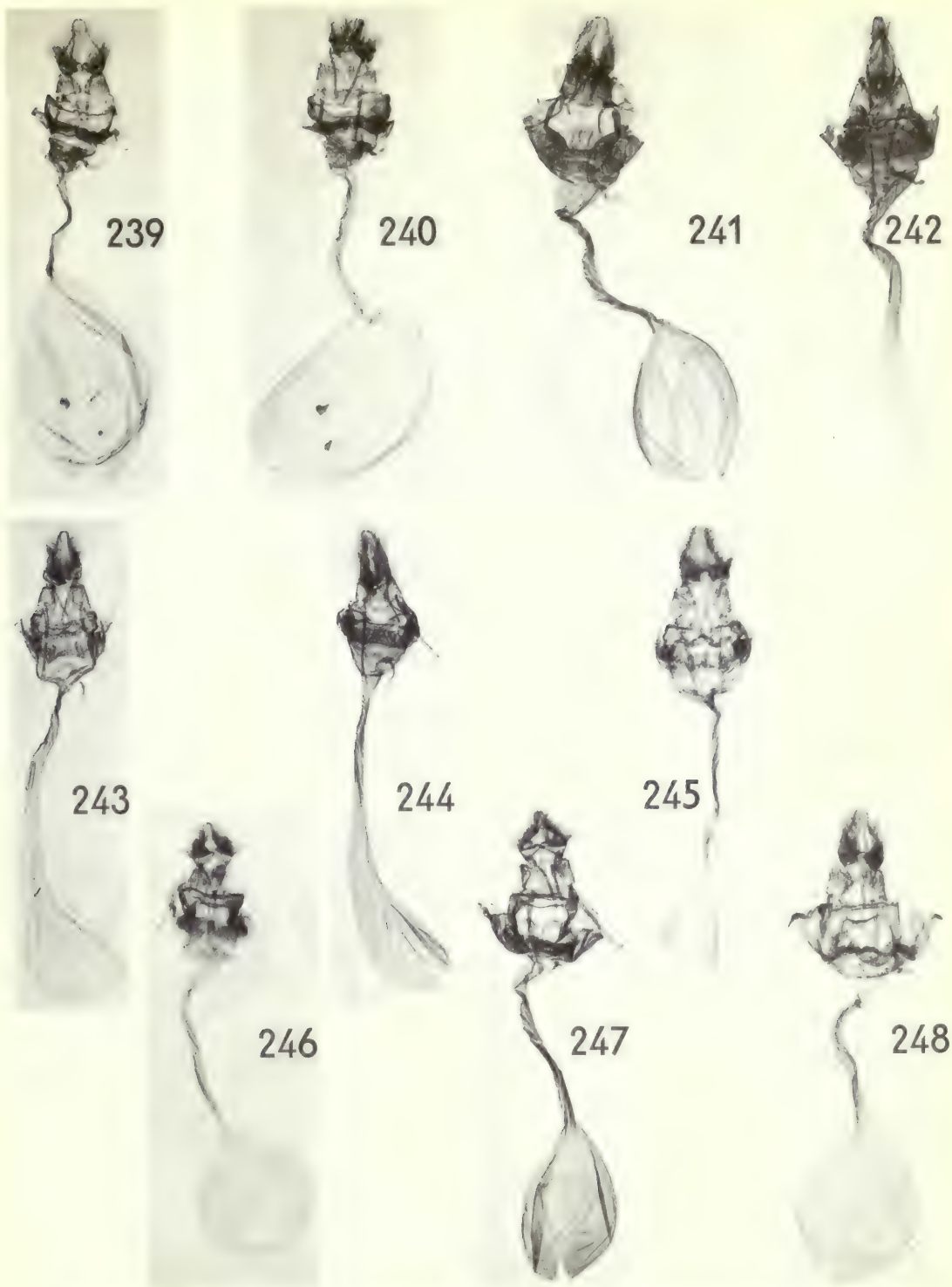
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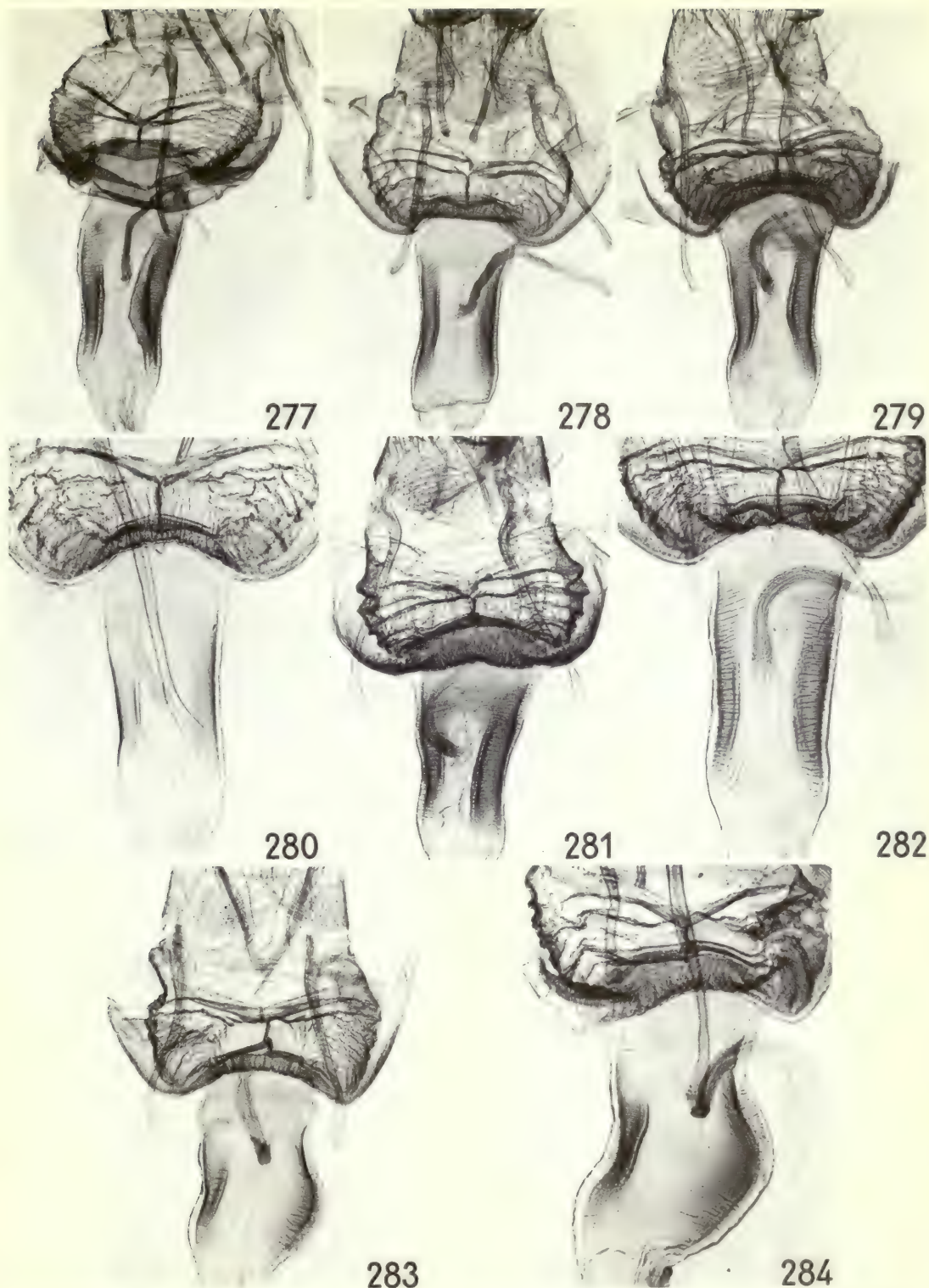


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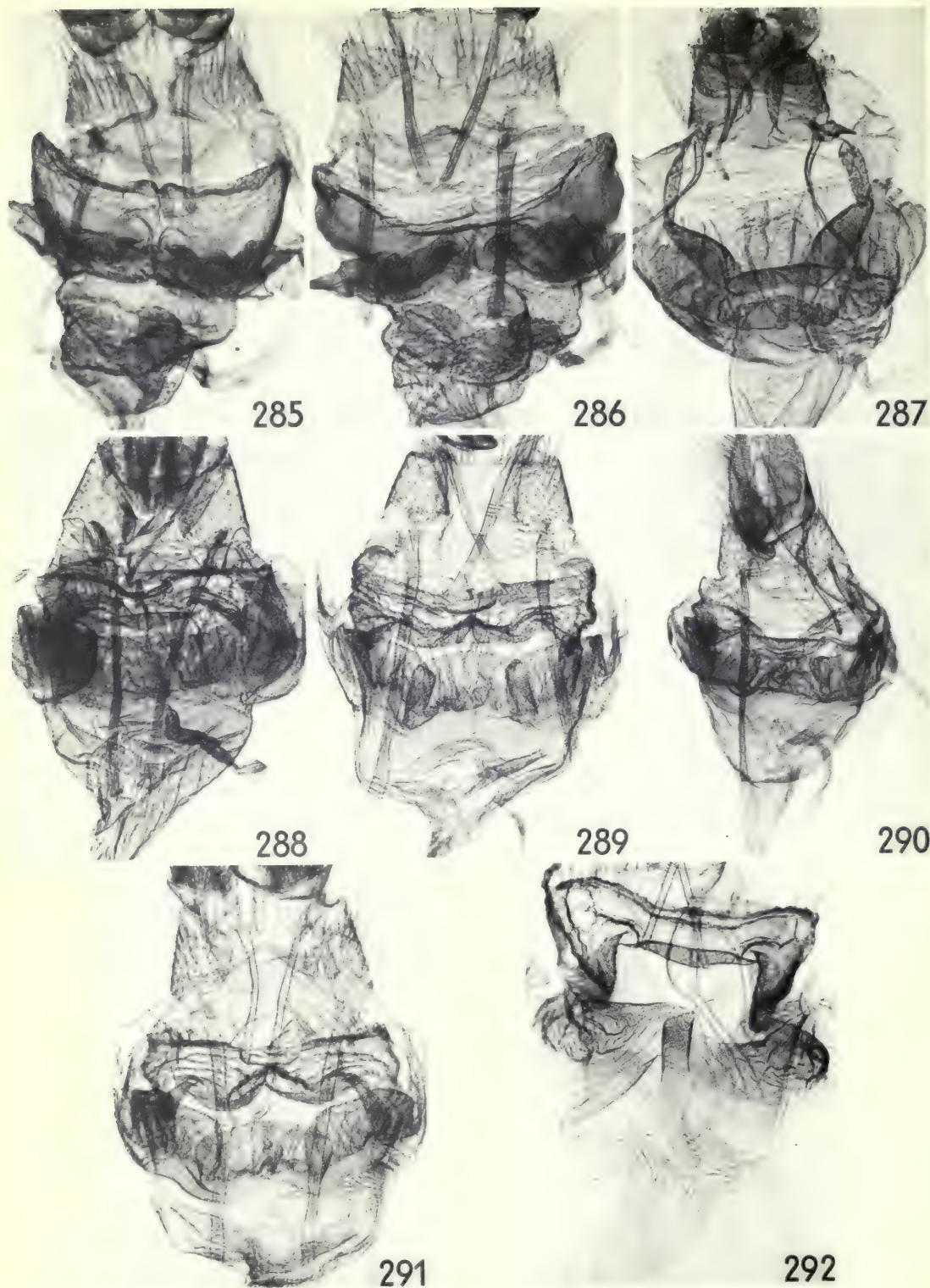


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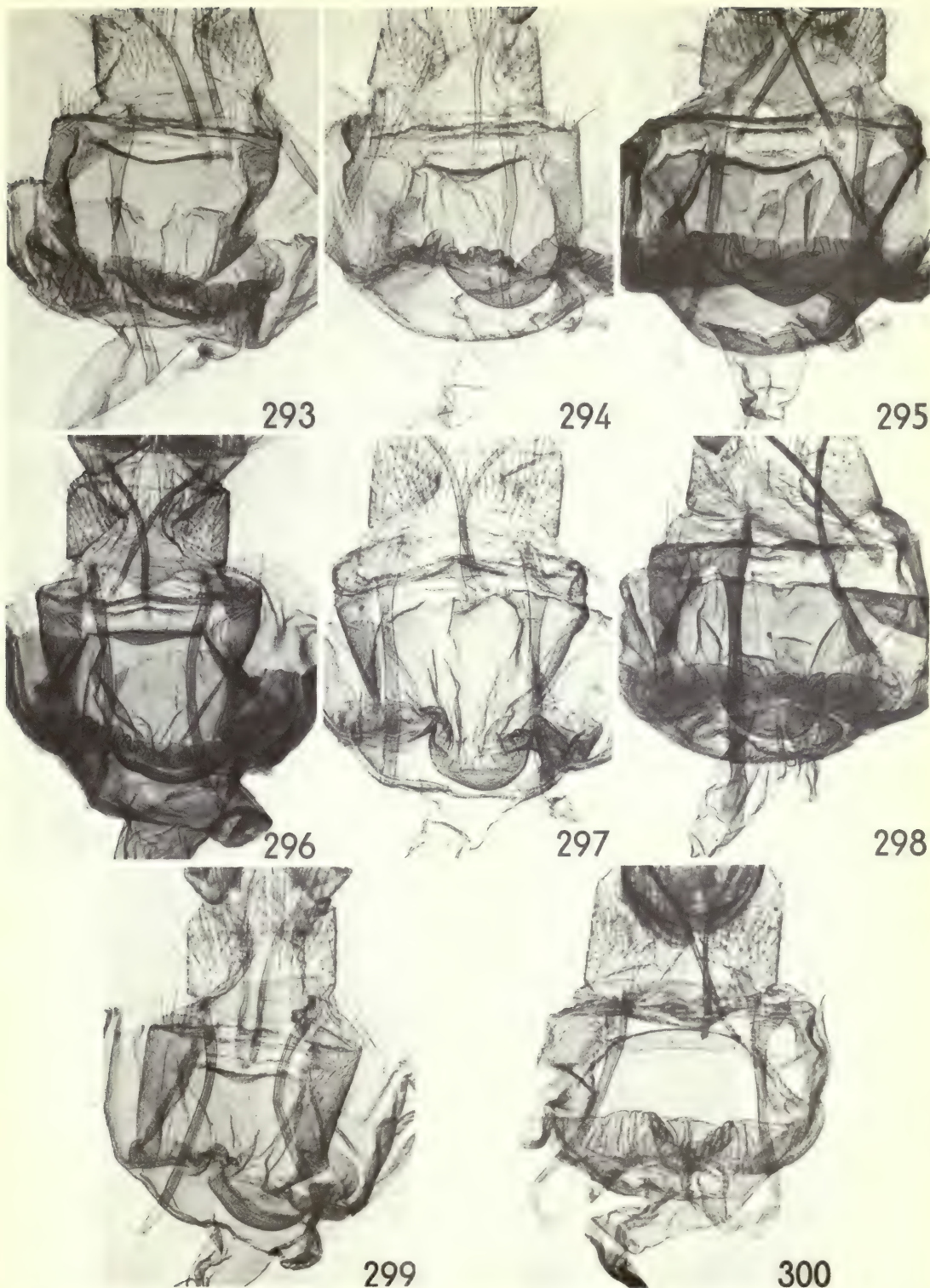
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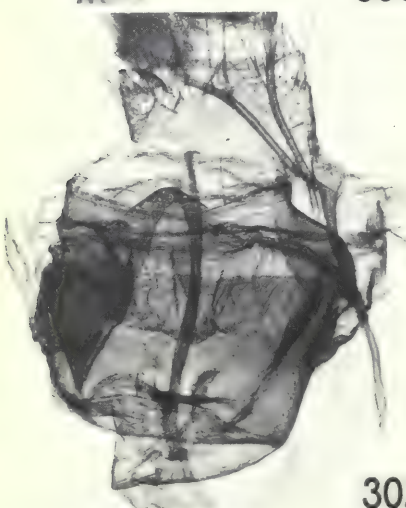
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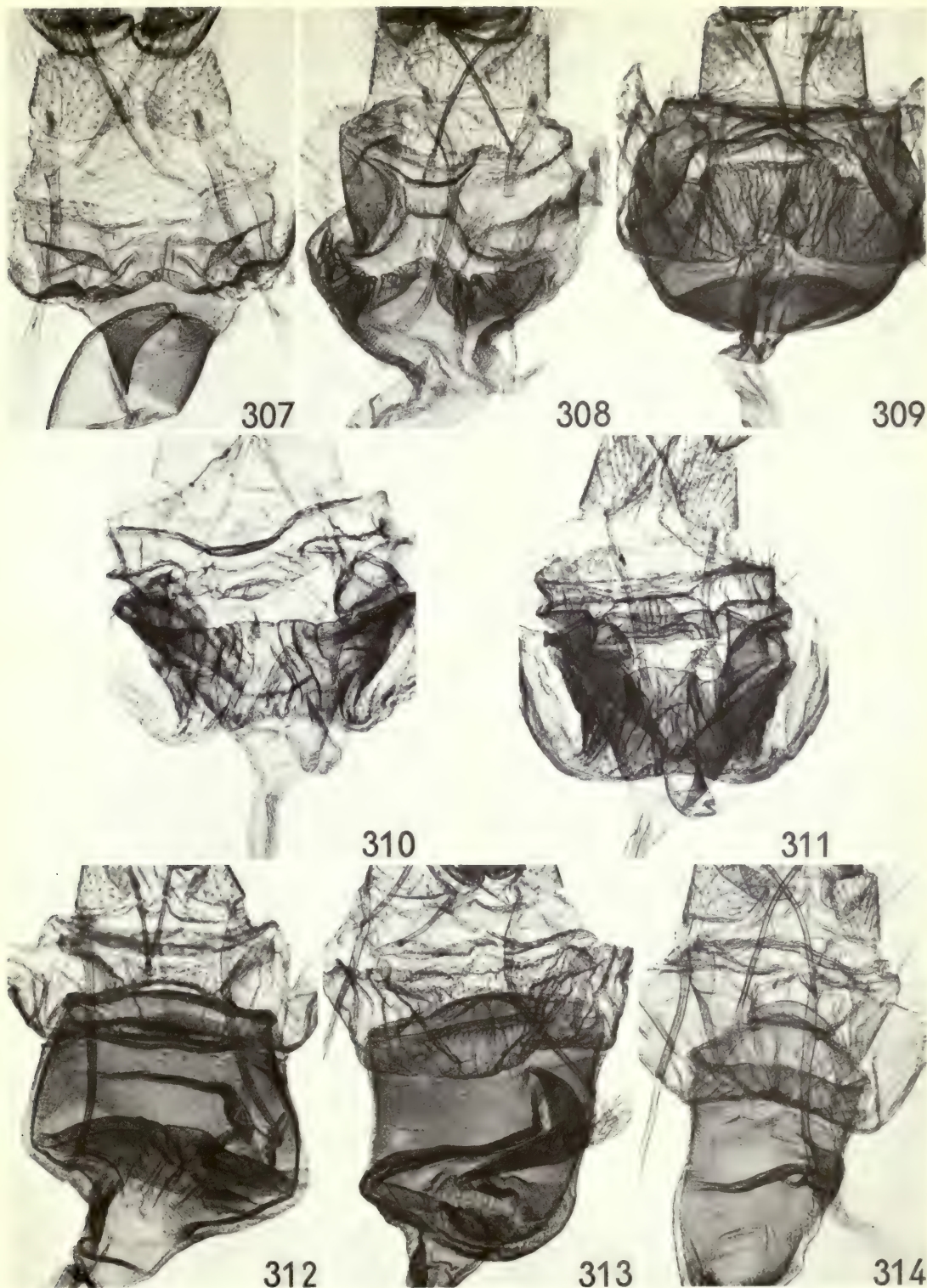


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